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COAST TO COAST

Friends of Chem. & Met.:

This is the editor, speaking to you from station EAST, atop the McGraw-Hill Building on West 42nd Street in New York City. The temperature here is somewhat akin to that of the interior of a byproduct coke oven—to be measured with a pyrometer. Humidity is at the well-known saturation point and indications are that solar radiation will continue to accelerate personal discomfort while retarding the physical processes of editorial production. Yet as we simmer in this crucible, one brilliant thought is born. Why not take all of you out to the Pacific Coast where meteorological conditions are conducive to the more normal functioning of our broadcasting facilities? Why not turn this program over to our California colleagues who at this moment are gathered for the greatest chemical conclave in western history?

Hence, a new coast-to-coast hook-up. On this history-making occasion, chemical engineers all over the country are to have an unusual opportunity to listen in on a great and colorful drama of industrial progress being enacted on the Pacific Coast. But why, you are asking, is there all this interest right now in chemical engineering out there? I believe there are many reasons. Most important, probably, is the prospective availability of low-cost hydroelectric power as a result of the huge governmental projects at Boulder Dam, Bonneville, and Grand Coulee. I need not remind you that electrochemical and electrometallurgical industries are the largest users of electric energy—that in 1929 such industries consumed one-tenth of the total electricity generated for industrial purposes.

Remember, too, that this hydroelectric power is backed up by low-cost and abundant fuel reserves of petroleum and natural gas. And, most important of all, that unique combination exists at *tidewater,* in the midst of growing markets, surrounded by nearly all of the mineral and agricultural raw materials essential to a sound industrial development.

Sorry. It's not my job nor do you wish me to sell you on the Wonders of the West. You want to hear directly from the scene of action. So now the microphone goes to my colleague, Dr. Paul DeVries Manning, Pacific Coast Editor of *Chem. & Met.* and supposedly hard-working secretary of the California section of the American Chemical Society. He has just returned from Waikiki Beach in Hawaii and while there he . . . . but that's another story.

California—take it away!

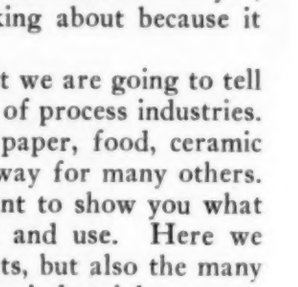
Hello, Everybody!

This is Manning, greeting you on this occasion from station WEST on old Mission Street, just across from the mint in the City by the Golden Gate. We like our sunshine out here, but are mighty glad right now to be in the chemical limelight again. Too bad the editor of *Chem. & Met.* is going into solution and cannot be with us. We are sorry, too, for the other thousands of you who couldn't make the trip on Charlie Parsons' or Billy Barr's crack trains, but we who are here will do our best to tell you what it's all about. With the able assistance of a galaxy of western stars, I hope we can give you a satisfying performance of pleasant and, perhaps, profitable entertainment.

Those of you who know me as a native son will now expect to hear all about California's wonderful weather and inspiring scenery, but I shall have to disappoint you. I am no McNamee. However, if you've never seen our skies as blue as methylthionine chloride, our palms and redwoods whose multitudinous supply of chlorophyl is stimulated every day by a solar radiation as soft and subtle as our occasional rains—well, I'll ask the tourist bureau to send you some of its alluring literature. In the meantime, something tells me that as chemical engineers and executives you are much more interested in facts and figures. And so, there will be no more chamber of commerce ballyhoo and propaganda on our program. Rather, we are going to let you hear from the men on the job, who talk our language and know what they're talking about because it is their life and work.

The plan for this program is very simple. First we are going to tell you about what we already have out here in the way of process industries. We are mighty proud of our petroleum, pulp and paper, food, ceramic and mineral industries. We believe they point the way for many others. Then, in the second section of our program, we want to show you what raw materials are available for your development and use. Here we include not just the mineral, farm and forest products, but also the many important chemical raw materials that are essential for industrial progress. Next, you are going to be presented with a remarkably comprehensive inventory of our power, fuel, water and transportation facilities.

What do all of these resources mean in terms of specific opportunities for chemical engineers? The answer will come to you in Section IV when well-known authorities will present the case for each of the three Pacific Coast states. And, finally, to help dispel any doubt that the West is not equipped to go ahead with a further large scale development of the process industries, I intend to present very briefly a few outstanding examples of chemical engineering equipment first developed on the Pacific Coast, but now of national interest to chemical engineers.



With that, our performance on the air will have been completed. But in order that you may have for permanent record and convenient reference all of the interesting data presented on this occasion from station WEST, we would respectfully refer you to the printed pages of this month's issue of *Chem. & Met.*

Now, on with the show!

Our Co-Broadcasters

Friends:

Your attention for a moment, please. Before proceeding with our program, I should like to take this occasion to introduce to this audience some of the remarkable talent that has been assembled for this coast-to-coast broadcast. A moment ago the editor of *Chem. & Met.* referred rather facetiously to my recent and absolutely necessary business trip to the Hawaiian Islands. I judge he was a bit worried about this performance which might well have been postponed had it not been for the generous offer and competent assistance of my editorial colleagues here in the McGraw-Hill Company of California. To George C. Tenney, editor of *Electrical West*, and his associate C. W. Leihy, engineering editor, my thanks are due for long and arduous labor. Incidentally, no pair of men to my knowledge has a better picture of power's possibilities here in the West. To Dr. Nathan A. Bowers, Pacific Coast editor of *Engineering News-Record* and to George J. Young and John B. Huttl, of *Engineering & Mining Journal*, must also go much credit for helping to maintain the McGraw-Hill family reputation.

Among the score of others who have contributed to this Pacific Coast program, are outstanding representatives of the universities, of the chemical and engineering professions and of nearly all of our important process industries. There is, for example, the man who has assumed the arduous duties of general chairman of this San Francisco meeting of the American Chemical Society, Prof. Arthur Lachman of the University of California, consulting engineer, whose name is associated with one of the most important recent advances in petroleum technology. The retiring chairman of the Division of Chemistry and Chemical Technology of the National Research Council, Prof. H. K. Benson of the Department of Chemical Engineering of the University of Washington gives us a remarkable picture of the potential chemical industries of the Puget Sound area. His active and aggressive associate, W. L. Beuschlein, speaks authoritatively of the pulp and paper industry. His neighbor, Prof. O. F. Stafford of the University of Oregon at Eugene, whose name is connected with a well-known process of hardwood distillation, presents the facts about Oregon's opportunities.

Industry's spokesmen include many familiar names and faces. R. E. Clarke, president of Marine Chemicals Co., Ltd., tells of magnesium compounds which he retrieves from the sea in his unique plant at South San Francisco. Fred C. Bowman, director of research of the Arthur R. Maas Chemical Co., frequent contributor to *Chem. & Met.* and a chemical engineer with many friends among former associates in the East, talks about the sodium phosphates and the little private warfare that is being fought along the southern sector of the western front. Then, up North there is Fred Shaneman of Penn Salt's Washington company, who knows something about other competitive situations in the electrolytic caustic soda and chlorine industry, and in the pulp and paper plants it serves. R. W. Mumford, consulting chemical engineer for Trona, who has been largely responsible for much of the large scale development and expansion program of recent years, talks of potash and soda ash and salt cake—tangible evidence of his versatile activities. Dr. Wilhelm Hirschkind, vice-president in charge of research and development for Great Western Electro-Chemical Co., is another old friend and frequent contributor to the advance

of western technology. Dr. Miner L. Hartmann, who came originally from the West and then served for six years as Carborundum's research director at Niagara Falls, has established a name and reputation in the ceramic industries of southern California. Raymond B. Stringfield is another native son who came East to take his chemical engineering at M.I.T. and who spent a number of years with Goodyear at Akron and Los Angeles before setting himself up as a consulting chemical engineer, a teacher, and a manufacturer and authority on dental plastics.

Paul A. Gross, production manager of California Chemical Co., couples wide experience in various chemical plants in the East and Middle West (including Dow, Rollin and Westvaco) with twelve years on the Pacific Coast with his present firm. He is a Case graduate of 1912. A. A. Blowski dates his connection with the sugar industry of the Pacific Coast from his graduation in chemistry from the University of California in 1910. After three years in the Alvarado beet-sugar refinery, he went with the California & Hawaiian Sugar Refining Corp. at Crockett as chemist and for eleven years has been its chief chemist.

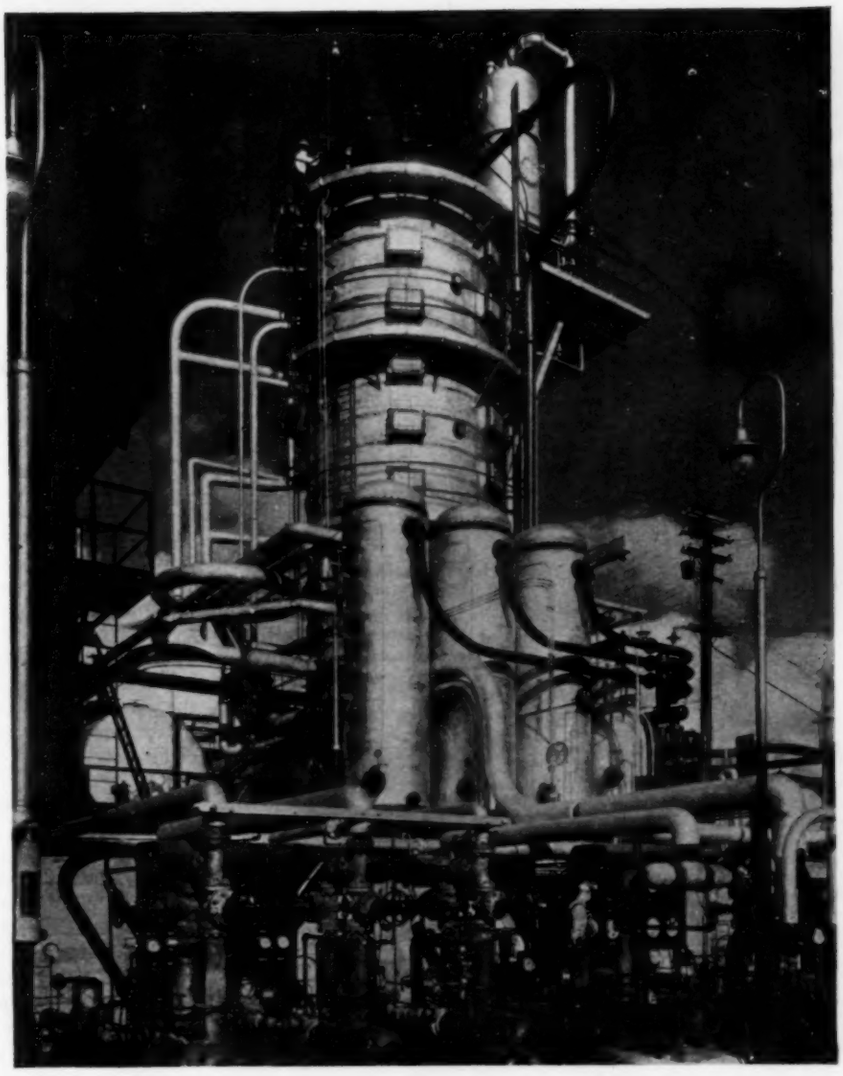
W. N. Williams is assistant to the president of the California Chemical Co., a Cornell chemist, who was with Warner Chemical in New Jersey for five years, and came to the Coast in 1929 as United Chemicals, Inc., western manager. Dan S. Green is in charge of production for all of the western plants of Stauffer Chemical Co.—another native son with eastern experience, who has gone back to the West to assume important responsibilities.

George A. Connell, superintendent of the Pacific Coast Borax Co., is a Stanford chemical engineer. After two years with A.S. & R. at Salt Lake City, he joined P.C.B.C. in 1918, successfully holding the position of chemist, chemical engineer, chief chemist and finally superintendent. Ross Cummings, consulting chemical engineer, was until recently chief chemist of the Emeryville Chemical Co. He is a University of California graduate in chemical engineering. Paul X. Smith of Durkee Famous Foods, Inc., of Berkeley, has a 12-year background in the vegetable oil industry of the Coast. A University of Iowa graduate, he came west in 1920, was with Union Ice Co. until he joined the Vegetable Oil Corp. in 1923.

Paul F. Bovard, consulting chemical engineer, specializes in water supplies and treatment. His professional background includes service with C. & H. Sugar, U. S. Reclamation Service, Union Fibre and U. S. Bureau of Standards. Dr. E. R. de Ong, consulting entomologist and agricultural technician, couples five years of practical farm and fruit-growing experience with several years as chief of the insecticide laboratory of the University of California and as former state horticultural officer. B. M. Burchfiel, ceramic expert for Gladding, McBean & Co., has been engaged in ceramic research and production work in southern California industrial plants since 1921. In 1918 he held the American Refractories Assn. fellowship at Mellon Institute. P. D. Buckminster, general superintendent of the General Paint Corp. of San Francisco, is well known in that industry both on the Coast and in the Middle West, where he formerly served as superintendent of the Martin Varnish Co., of Chicago.

Claude C. Brown, chief engineer of the California State Railroad Commission, graduated from U. of C. in electrical engineering in 1914. Following ten years as assistant chief engineer of C. & H. Sugar, he joined the commission staff and in 1927 was also made natural gas administrator for the state. Otto Herres, assistant manager of the United States Fuel Co., A. S. & R. subsidiary, speaks authoritatively on coal resources as a result of varied experience in the mines of Colorado, Utah and Nevada dating from his graduation as a mining engineer from the Colorado School of Mines in 1911.

Hal M. Remington, general secretary, Pacific Coast Transportation Advisory Board, qualifies as an authority because of ten years with western railways, eleven years with the I.C.C. and fifteen years as chief traffic executive of various commercial organizations in California. His coauthor, Ralph B. Koeber, was for twelve years manager of the research department and industrial engineer in charge of special investigations for the San Francisco Chamber of Commerce. Previous experience was with the U. S. Irrigation Service, Utah State Highway Commission and Salt Lake City Engineering Department.



Process Industries Point the Way

WHAT has been accomplished to date by the petroleum industry of California, the pulp and paper plants of the Pacific Northwest or the potash and borax producers of the West are but signposts pointing the way toward the greater progress ahead. That is, if the combination of chemical engineering and cheap power at tidewater can unlock the vast resources of raw materials now awaiting industrial development.

Lachman treater for refining gasoline with hot concentrated solutions of zinc chloride

PETROLEUM REFINERS DEVELOP MANY UNIQUE PROCESSES

By **ARTHUR LACHMAN**
Consulting Engineer, Berkeley, Calif.

CALIFORNIA petroleum has characteristics which in many ways are unique. In general, the gravity is low, which is equivalent to saying that the gasoline content of the crude oil is low. Oil from the enormous Kettleman field is a marked exception. Gasoline prepared from California oil also has properties which mark it off from that produced elsewhere. The sulphur content is frequently high. The crude oil also contains relatively large quantities of nitrogen compounds which find their way into gasoline produced by cracking. In a third respect, California gasoline is unique in that it has a naturally high octane number. Gasoline distilled from the crude of the Los Angeles Basin will have an octane number not much below 60. Even before our present system of knock rating was developed or before we knew much about the undesirable influence of pre-detonation, the peculiar advantages of California gasoline were recognized to such an extent that "California gasoline" was selling in Eastern markets at a premium of approximately 2c. per gal.

At one time the production of kerosene in California was an important item, since shipments to the Orient and to Australia had their logical starting point on the Pacific Coast. The completion of the Panama Canal, however, and the economic disturbances following the Great War have considerably changed the picture, so that the export of "oil for the lamps of China" has shrunk to a mere fraction of its former volume.

Lubricating oil is also produced in California, although many of the crudes are of an asphaltic nature and yield little or no "lube stock." Here and there, however, there are fields which contain useful quantities of this ingredient, and, in fact, California manufactures a far larger amount of refined lubricating oil than it can conveniently market. In consequence, prices are low.

There has always existed a controversy regarding the merits of "Western" and "Eastern" lubricating oil. This dispute has never been settled and there is probably no justification for it. We find, in fact, that one branch of the government service prescribes Western oil for its service and that another department demands Pennsylvania oil. The truth is that California produces two types of oil, one of which is characteristic of California; the other closely resembles Pennsylvania oil. Recently one California oil company has been producing a third type of lubricating oil which it claims is "better than Pennsylvania oil."

Even though the natural octane number of California gasoline is high, cracking has been practiced on a large scale. There have been two reasons for this. In the first place, California is a country of hot summer climate with a considerable area of mountains. It has been found necessary to market a gasoline of about 70 octane in order to meet average touring conditions for the average car. The second and perhaps more important reason for the expansion of the cracking art in California is found in the low yield of gasoline in natural crude oil.

The crude oils of the Los Angeles Basin will not produce an average yield of 30 per cent of gasoline. The same is true of the oils of the San Joaquin Valley, with the exception of Kettleman. That crude will yield from 40 to 50 per cent of gasoline; but it has a low octane number and usually must be cracked (re-formed) to make it marketable under California motoring conditions. In other words, Kettleman gasoline is more like Mid-Continent than California gasoline. The introduction of cracking has enormously increased the proportion of gasoline which can now be obtained from California crude and all of the important refineries practice cracking on a very large scale. It is interesting to note that the original experimental work on the Dubbs cracking process was carried out in California near Santa Maria.

THERE is another source in California which produces large quantities of gasoline. This is the so-called "natural" or casing head gasoline. Practically every field in California is equipped with plants for the extraction of this valuable material from natural gas.

The refining of gasoline produced either from casing head or by topping of crude offers no technical difficulties in California. The raw product is usually treated with small amounts of sulphuric acid (as little being used as ¼ to ½ lb. per bbl.). The acid treated crude gasoline is then washed with an alkali and usually marketed without further treatment. Occasionally it may be redistilled.

On the other hand, cracked gasoline as produced in California was for many years a source of great difficulties to the refiner. The use of even large quantities of sulphuric acid under ordinary treating conditions gave far from satisfactory results. The use of inhibitors for preventing gum formation or for the increase of color stability, a procedure which has been found quite useful elsewhere, accomplishes little or no good on California cracked gasoline. The treatment of gasoline vapors with clay (Gray process) as widely used in the Mid-Continent has never given satisfactory results in California.

It is not surprising, therefore, that these peculiar difficulties have given rise to distinctive refining processes for cracked gasoline in California. Space is available for mention of only two of these:

(1) The Standard Oil Co. of California has developed a method of treating cracked gasoline with large proportions of sulphuric acid (10 to 25 lb. per bbl.) at low temperatures down to 0 deg. F. (Halloran process). This process, which is operated in three steps, gives very satisfactory results and in particular is capable of reducing the sulphur content to any desired figure, provided sufficient acid be employed. Owing to the low temperatures at which the process works, losses of gasoline due either to solution in the acid or to polymerization are much lower than might be expected; they do not as a rule exceed 10 per cent. After treatment with acid under the described conditions, the gasoline must be redistilled in order to eliminate the dialkyl sulphates which are soluble in the gasoline phase.

(2) Another unusual procedure for refining of cracked gasoline was developed by the Richfield Oil Co. This process treats gasoline vapor with hot concentrated solutions of zinc chloride (Lachman process). The zinc chloride process may be operated in two forms. In the first, gasoline produced by cracking is condensed and washed to remove hydrogen sulphide, mercaptans, phenols, etc.; it is then evaporated in a pipe still, the vapors treated with zinc chloride solution and condensed again. In another form, vapors coming directly from the cracking plant and containing all of the gases and other impurities which may be normally removed by washing, are sent directly into the zinc chloride system, thereupon condensed after fractionation, and separated from the fixed gases.

The original plant installed by the Richfield Oil Co. at Wilmington, Calif., uses the redistillation system. Several other plants in the United States, Canada, France, Germany, and South Africa employ the direct system, treating the vapors as they leave the cracking plant. Solution and handling losses in the zinc chloride process are less than 1 per cent. Polymerization losses vary with the type of stock being treated; they range from 1 to 3 per cent, the latter figure being reached with so-called "vapor phase" cracking. Zinc chloride treatment removes part but not all of the sulphur content of cracked gasoline. The average reduction of sulphur is from 30 to 40 per cent.

The refining of kerosene in California follows standard practice. The kerosene stock is usually treated exhaustively with oleum and redistilled.

The refining of lubricating oil in California has, until recently, followed conventional practice, namely, treatment with large quantities of sulphuric acid followed by washing with caustic soda and completed by redistillation in vacuum. A year ago, however, the Union Oil Company of California installed, at Oleum, its own development of the solvent refining process. The Union process selects only the most desirable lubricating bodies and rejects all others in refining crude oil:

Starting with the crude itself, the gasoline, kerosene, and gas oil fractions are removed by topping. The remaining portion, known as residuum, contains the lubricating bodies, together with some asphalt and wax. To obtain the finished product from this material, four operations are necessary:

1. Distillation under high vacuum (to avoid cracking) separates the oil into the proper SAE viscosity grades and removes most of the asphalt.

2. Propane deasphalting removes the remainder of the asphalt. This operation takes advantage of the fact that asphaltic bodies are insoluble in liquid propane; consequently, when the crude distillate is mixed with liquid propane the asphalt separates and is easily removed.

3. Propane dewaxing is attained through self-refrigeration. Propane boiling at minus 40 deg. F. under atmospheric pressure chills the mixture and causes the wax to separate. After filtration the oil is remarkably clean and of very low pour point.

4. Solvent treatment, to remove all unstable, low-grade materials, is carried out in two steps:

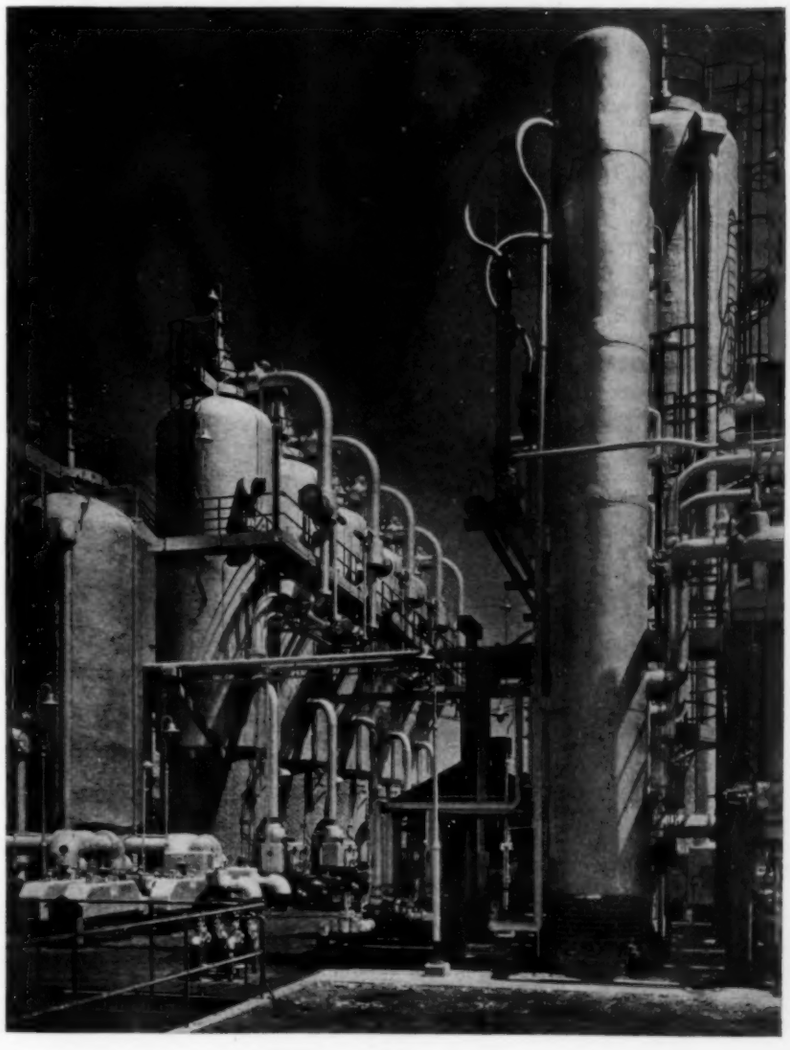
(a) Liquid sulphur-dioxide, to remove most of the aromatic and some of the naphthenic fractions.

(b) Liquid sulphur-dioxide plus benzol, to remove the remaining naphthenic and aromatic fractions.

As a final finishing operation, the oil is treated with decolorizing clay.

California's importance as an oil center is still considerable. Six or seven years ago, before discovery of the East Texas fields, large quantities of Cali-

New installation of Union Oil Company at Oleum, Calif., for producing lubricating oil by the solvent refining process



fornia crude were shipped to the Atlantic seaboard and to other parts of the world. At the present time, the chief market of California oil products is the Pacific Coast itself. This section, containing less than 10 per cent of the population of the United States, operates over 15 per cent of the automotive units in the country. In addition to this high proportion of motor cars and trucks, the mild winter climate of the entire coast, the excellent roads, and the fact that the population of this region is "touring minded," all contribute to a high consumption of petroleum products. Except for portions of the state of Washington, practically all of the requirements of the Pacific Coast are filled from California fields.

Potential production of California wells, operating and shut in, is reported as over 1,700,000 bbl. per day. Actual production, due to economic conditions and to a fairly successful scheme of allocation, is about 520,000 bbl. per day. Approximately half of this production is marketed in the form of gasoline. The average price of California crude at the wells is not far from $1 per bbl. The wholesale value of the manufactured products is close to $2 per bbl., so that the oil industry has a wholesale turn-over of $1,000,000 per day. The retail value may again be assumed as double, so that the importance of the industry to California is measured by a sum exceeding $700,000,000 per year.

Lubricating oil requirements of the Pacific Coast are estimated at 80,000,000 gal. per year. Something over half of this quantity is supplied from California sources at the present time.

Rubber Industry

By R. B. STRINGFIELD

Consulting Chemical Engineer, Manager, Dental Plastics Co., Los Angeles, Calif.

NOT WITHOUT foresight have the "big four" of the rubber industry, Goodyear, Firestone, Goodrich and U. S., by locating plants at Los Angeles, made it the world's second largest rubber center. Of some 24,250,000 motor cars and trucks registered in 1934 in the United States, 2,120,453, or approximately 8.7 per cent, were registered in California and, while the depression had its effect and both the reduced production and the unusually low price of rubber brought the value of tires and tubes produced in this area from a 1930 figure of $53,500,000 to a 1933 low of $21,000,000, present production is on a considerably higher level and the industry reflects the increasing prosperity of the Pacific Coast.

The last few years have seen rapid changes in tire production methods and, while there have been no major plant expansions, Western plants have kept up-to-date by installing the latest in improved methods and equipment, and have originated a number of improvements which have been adopted elsewhere by the industry. A large percentage of rubber compounds has been switched from mixing on rolls to mixing in Banbury internal mixers, with large resulting savings in power and labor. Much stock is now fed direct from the mixing mills to the calenders or tube machines, reducing inventories of stock in process by many thousands of pounds. Improvements in curing have shortened the time necessary and increased the turnover on molds. On the other hand, the trend toward larger passenger tires has greatly reduced the rated capacity of existing plants, which for the Los Angeles area now does not exceed some 25,000 tires per day, although this would be greatly increased by a relatively small amount of new equipment.

Owing to universal good roads which permit long tire carcass life retreading is an important item in the Western rubber picture. All the large companies engage in this field, and there are also several very active smaller companies, it being estimated that 5,000 tires per day are retreaded in the Los Angeles area alone.

While tire production consumes the bulk of the rubber tonnage, several active and flourishing plants specialize in mechanical rubber goods for the Western industries. Largest plants of this group are those of the E. M. Smith Rubber Co., Rubbercraft Corp., Kirkhill Rubber Co., and West American Rubber Co., all of whom make many lines of novelties, plumbing supplies, and particularly oil field equipment. The West American Rubber Co. has a Farrel-Birmingham roll grinder, and services calender rolls for all the companies on the coast. This company has also recently acquired the American rights for the French Crinolex process for rubberizing hair for upholstery, which promises to become important.

The D & M Machine Works at Torrance, near Los Angeles, acquired a national reputation for their piston rubbers for oil field use, and have now added an all-rubber garden hose and a duplex all-rubber oxy-acetylene hose to their line. The Pacific Hard Rubber Co. produces several types of battery boxes. The W. J. Voit Rubber Corp. manufactures a widely used line of toys and playballs. The Darnell Rubber Corp. at Long Beach is a nationally known producer of castors, and manufacturer of golf balls, air mattresses, and many other specialties. Even the movies demand rubber products, the masks for "Alice in Wonderland" and the gauzy fairy wings for "Midsummer Night's Dream" being locally made from compounded latex.

Being located on tide water, Los Angeles is favorably situated both with regard to incoming raw materials and to export shipments, the latter in spite of the opening of Goodyear subsidiaries in Sydney, Australia, in 1928 and Buitenzorg, Java, in 1935, still amounting to a sizable figure. Of the more important raw materials, rubber from the Far East, sulphur from Texas and some cotton from Southern states come in by boat. Carbon black from Texas and zinc oxide from several sources chiefly come by rail. Talc, mineral rubber, reclaimed rubber, solvent naphtha, and so forth, are produced locally. Reclaim and rubber scrap are important export commodities, the former particularly to England, and the latter to China and Japan.

DUE to the industrial demand for natural gas and the proximity of populated areas, production of carbon black by the usual channel process from local gas has not been feasible. Much work has been done by several interests in the effort to produce blacks for the rubber industry from petroleum, but so far without complete success. An outstanding development, however, is that of hydrogenated fish oil produced by W. C. Hardesty Co., Inc., of Wilmington, Calif., which under the trade names of Hydrex and Batex has replaced a great deal of the stearic acid formerly used for activating and plasticizing rubber compounds. Lauric acid produced by the Los Angeles Soap Co. from coconut oil also finds use as a rubber softener. The new plant of Hughes-Mitchell Processes, Inc., now under construction at Torrance, is expected to produce a substantial amount of zinc oxide and lithopone.

Although not as large as the Los Angeles industry, the San Francisco Bay territory contains a number of thriving rubber factories. Particularly to be mentioned are the Pacific Rubber and Tire Mfg. Co. of Oakland, making special brand tires and tubes, the Keaton Tire and Rubber Co. of San Francisco, making tire repair stocks and also equipment specialties, the American Rubber Co. of Oakland, making large fire hose, suction hose and conveyor belting, and the Oliver Tire and Rubber Co. of Oakland, making tire repair stocks and equipment.

Little publicized, but not least in importance among products of the Western rubber industry is men. The Los Angeles plants have proved valuable training grounds, and men who acquired much of their experience in the West are now responsibly connected with rubber factories throughout the world.

PULP AND PAPER

By W. L. BEUSCHLEIN

Associate Professor of Chemical Engineering
University of Washington, Seattle

WOODED REGIONS bordering on the Pacific Coast represent vast areas which supply much of the raw materials for the manufacture of pulp and paper. Pulp woods extending from northern California well into Alaska have been surveyed, studied and classified so that reliable figures are now available as to abundance of species, rate of natural reforestation, and rate of depletion due to cutting, fires, and insects. For the area composed of western Oregon and western Washington, wherein the majority of pulp mills are located, about one-third of the present stand of timber consists of pulping woods, the balance being Douglas fir. The latter is used to a minor extent in kraft and soda mills and may be classed as a possible future source of pulpwood. For the area mentioned in Oregon and Washington there are approximately 40 billion cubic feet of pulp woods now standing. This volume is made up of western and mountain hemlock, Sitka and Engelmann spruce, and white, amabilis, noble and alpine firs. Approximately 60 per cent of the pulp stand is western hemlock. In northern California, large areas of redwood and white fir are available.

Natural reforestation has resulted in most cases in the regrowth of pulping woods at ratios greater than those originally existing so that where virgin forests consisted of 40 per cent pulp woods, the new growths average 50 per cent or better. Munger (*Pacific Pulp and Paper*, September, 1934) states that reforestation is adding at present one billion cubic feet per year and that after the stagnant growth in the virgin forests has been removed, two and three-quarters billion cubic feet may be expected to be the yearly regrowth. Estimating one-third of this as pulping woods and the present annual consumption to be one and one-third million cords, it is apparent that the area will suffice to supply perpetually a much larger industry than at present.

For the inorganic chemicals which enter into pulp and paper manufacture, limestone, sulphur, soda, glauber salt, and bleach are the more important. Local limestone is available by a single water haul to a majority of the mills.

Approximately 70,000 tons of sulphur were imported last year for the sulphite industry into Washington and Oregon and 20,000 tons for a like purpose into British Columbia. Sulphur is largely of Gulf States origin although considerable thought is being given to pyrite deposits in Washington. The pulp industry requires a variety of bleaching and oxidizing materials among which are chlorine, chloramine, and zinc hydrosulphide. These are made either directly or indirectly by electrochemical companies located at Pittsburg, Calif., and Tacoma, Wash. Sodium sulphate for the kraft mills has been imported from Austria, Germany, and from the Eastern states notwithstanding substantial natural deposits in eastern Washington and Nevada. Soda ash, silicate of soda and alum are supplied from California and the Eastern states.

Pacific Coast mills have been located in the most part on tidewater which affords ocean rates for outgoing pulp and low towage for logs. Pulp wood prices in Oregon and Washington have steadily decreased during the past decade and are now at the all time low of $4.50-$6.00 per cord. Location of mills in conjunction with saw mills not only affords low steam costs but also proportioning of saw logs and pulp wood so as to give minimum logging costs in the forests. Saw mill waste is an important source of pulp wood.

Production on the Coast has steadily increased during the past decade with the exception of the years 1931, 1932 and 1933. This region leads others of the United States in tonnage of sulphite produced while the South holds the same position for kraft.

The majority of the Western mills represent the latest developments in design and operation. In the sulphite mills, indirect heating and forced circulation of cooking liquor, pressure absorption, multiple bleaching, and pretreatment of chips have been accepted as important contributions to the industry. Vacuum drying has proved to be a valuable operation.

Considerable pulp is used on the Coast for the preparation of roofing, boards, felts, insulating papers, and industrial flooring. Asbestos paper is manufactured by Johns-Manville Corp. at Pittsburg, Calif. Practically all of the bleached sulphite pulp made in Washington is shipped to the Eastern seaboard where it finds a market in the rayon industry. Shipments have also been made to Japanese viscose mills. At present no Pacific Coast mills are converting viscose into yarn but some work has been done toward the sealing or enclosing of certain fruits and vegetables within viscose films. While the picture of fresh fruits encased in thin, transparent, germ- and moisture-proof wrappers may excite our imagination, some real problems must be first solved before it will be realized. Approximately 1,000 tons daily of bonds, writing specialties, and book papers are produced along the Coast, and an equal volume of kraft is converted into fruit wrappers, napkins, box and container board, bag and general wrappings. Cartridge, semi-parchmentized and grease-proof wrappings, glassine, and bottle cap board may be mentioned among the new and less common paper products now being produced.

Pulp Production in Tons

	1933	1934
Washington	583,770	709,380
Oregon and California	189,332	240,167
British Columbia	323,431	355,165
Total	1,096,533	1,304,712
Total U. S. production	4,329,248	4,490,859

Daily Pulp and Paper Capacities of Pacific Coast Mills in Tons

	British Columbia	*Washington*	*Oregon*	*California*
Pulp				
Mechanical	680	620	605	...
Unbleached sulphite	380	867	380	...
Bleached sulphite	120	1,170	100	...
Sulphate	180	640	115	...
Soda	....	75	....	....
Total	1,360	3,372	1,200	...
Paper				
News	850	425	485	...
Sulphite	75	545	263	65
Sulphate	60	370	120	...
Book	....	125	....	....
Board	25	350	....	568
Miscellaneous	....	18	8	271
Total	1,010	1,833	876	904

CANE AND BEET SUGAR

By A. A. BLOWSKI

California and Hawaiian Sugar Refining Corp., Ltd., San Francisco, Calif.

A SURVEY of the sugar industry of the Pacific Coast must in reality cover two separate and distinct industries, the cane sugar refining industry and the beet sugar industry. Both of these are concentrated chiefly in the state of California, the former centering entirely on San Francisco Bay and the latter, with the exception of one plant in the state of Washington, being scattered through central and southern California. The combined output of these industries on the Pacific Coast amounts to approximately 1,000,000 tons of sugar per year, or about one-sixth of the annual consumption in the United States.

The Pacific Coast sugar refining industry includes two refineries located on San Francisco Bay: one owned by the California and Hawaiian Sugar Refining Corp., Ltd., and located at Crockett about 30 miles northeast of San Francisco; the other owned by the Western Sugar Refinery and located in San Francisco. Their combined output is 700,000 to 750,000 tons of refined sugar per year, or a little less than one-fifth of the output of all United States refineries.

The C&H refinery at Crockett, instead of being located in a large city, differs from most of the American sugar refineries in being located in a small industrial town supported solely by this industry. Though somewhat apart from the main industrial center of the state, the plant is on deep water and well situated for receiving raw sugar and for shipping by rail and water. This refinery has a capacity of 2,750 tons of raw sugar per 24 hours and is rated as the largest individual sugar refinery in the world. It is a cooperative enterprise, being owned jointly by 29 sugar plantations in the Territory of Hawaii. It was erected by them in 1906 in order to convert their raw sugar into a finished product and thus assure themselves of an established market for their output.

These Hawaiian plantations annually ship between 500,000 and 600,000 tons of raw cane sugar to Crockett where it is refined, the refined product being distributed chiefly by rail to the Western and Missouri River markets and by water through the Panama Canal to other points mostly located in the neighborhood of the Great Lakes. This sugar represents about 70 per cent of the raw sugar crop of the plantations owning the refinery and a little more than half of the entire Hawaiian crop. The Hawaiian raws refined at Crockett are somewhat higher polarizing than those normally handled in Eastern refineries, testing a little below 98 deg., as compared with Cuban, Puerto Rican and Philippine raws testing from 96.5 deg. to 97 deg. which are handled on the East Coast.

THE Western Sugar Refinery, located in San Francisco, is rated as having a daily capacity of 1,400 tons of raw sugar per 24 hours. This plant also refines Hawaiian raws and in addition a considerable quantity from the Philippine Islands. The refined sugar from this plant is likewise distributed on the Pacific Coast and eastward to Middle West points.

Though the two refineries have been in operation for many years, they have been greatly improved and enlarged from time to time and are both thoroughly modern refineries of the bone charcoal type, which type is nearly universal in this country. While following in a general way the standard refining methods of this country each of these refineries has developed a number of special improvements of their own. Many of these consist of details of process and control not readily described in a few words, but some are quite striking even to the casual visitor. Among them is the novel and interesting equipment for producing and drying cube sugar which is used at Crockett. This equipment produces and dries cubes continuously and semi-automatically, materially reducing the labor and handling formerly required. Another novel and interesting process is that utilized by both plants for producing the sparkling crystal tablets so popular for table use. This process, which was first developed at the Western Sugar Refinery, is far simpler than the older process and requires much less labor and equipment. Still another innovation is the efficient system used at the Western refinery for handling bags in its refined warehouse. Natural gas is the fuel used at both plants.

The Pacific Coast has the double distinction of having the oldest successful beet sugar factory in the United States and also the largest beet sugar factory in this country, if not in the world. The first successful beet sugar factory in this country was erected at Alvarado, Calif., in 1879, after preliminary less successful runs in an earlier plant erected on the same site in 1870. This plant, with many enlargements and changes over the years, is still operating profitably. The largest beet sugar factory in this country, with a rated capacity of 5,000 tons of beets per day, is located at Spreckels, Calif.

The combined output of the Pacific Coast beet sugar factories in recent years amounts to approximately 275,000 tons of white sugar, or in the neighborhood of 20 per cent of the nation's output of beet sugar. The total acreage of beets required in 1934 for this output

One of the largest cane sugar refineries in the world, the California & Hawaiian Sugar Refining Corp. plant at Crockett about 30 miles northeast of San Francisco

was approximately 115,000, the yield of beets being over 1,600,000 tons. Agricultural conditions in California are very favorable for the production of beets, the normal yield averaging about 15 tons per acre compared with 10 or 11 tons for the country as a whole, and the sucrose content of the beets averaging about 18 per cent compared with about 17 or less for the entire nation.

These factories vary greatly in age but in nearly all cases they have kept up with new developments and with few exceptions may be considered modern beet sugar factories. Most of them are equipped with Steffens plants for desugarizing molasses. Of particular interest is a new continuous Steffens process developed in the plant of the Spreckels Sugar Co. which is understood to show many advantages over the standard process.

Pacific Coast Refineries

Company	Location	Rated Capacity Tons Beets per 24 Hr.
Spreckels Sugar Co....	Spreckels, Calif.	5,000
Spreckels Sugar Co....	Manteca, Calif.	1,800
Holly Sugar Corp.....	Alvarado, Calif.	1,400
Holly Sugar Corp.....	Tracy, Calif.	1,500
Holly Sugar Corp.....	Santa Ana, Calif.	1,400
American Crystal Sugar Co.....	Oxnard, Calif.	3,500
Amalgamated Sugar Co.....	Clarksburg, Calif.	1,600
Union Sugar Co.....	Betteravia, Calif.	1,200
Utah-Idaho Sugar Co..	Bellingham, Wash.	1,000

CERAMIC CLAYS

By MINER L. HARTMANN

Consulting Chemical Engineer, Los Angeles, Calif.

THE Pacific Coast states have deposits of almost every kind of non-metallic mineral, and these are so widely dispersed throughout the area that they are readily available and accessible for use in or near the manufacturing centers. In California, particularly, the non-metallic mineral deposits have been extensively explored and developed, and raw materials in almost unlimited quantities are available for the chemical and process industries.

Building bricks, fire bricks and hollow tile for building purposes are manufactured in many locations in the Pacific states, and because of the low price, consumption is limited generally to the contiguous territory, except in the case of high-quality fire brick, which are shipped considerable distances. During 1934, products of this type to the value of $1,450,000 were produced in California alone, which reflects the low rate of building construction, for by comparison, this figure for the years 1921 to 1930 averaged approximately $7,000,000.

Fire clay and siliceous brick, as well as some of the more highly specialized high-temperature refractories, are now produced in the Los Angeles, San Francisco and other industrial districts.

Also, production of other types of ceramic products is large. The colorful tile roofs and the attractively colored art pottery and china have long been recognized as part of the romantic "atmosphere" of California. In 1933, the total production of "Pottery Clays" including those used for red and brown earthenware, china, sanitary ware, flower pots, floor, faience and ornamental tiling, architectural, terra-cotta, sewer pipe, drain and roofing tile was reported as 141,629 tons valued at $211,711 at the point of production, and this was from 19 counties and 51 separate properties. By comparison, this production averaged about 600,000 tons from 1921 to 1930. Since most of the reported production is from deposits worked by manufacturers, the values given in the above statistics probably represent nearly the production cost of the clay at the pits or mines.

THESE pottery clays were used in the production of many types of ceramic wares, as indicated by the compilation by the Division of Mines for 1933:

Pottery Clay Production, 1933

	Producers	Tons	Value
Architectural terra-cotta.	6	3,827	$366,957
Chimney pipe and flue tile	8	3,289	99,661
Drain pipe.....	17	2,589	42,140
Roofing tile.....	22	26,893	309,002
Electric porcelain.....	5	.....	393,131
Red earthenware	7	.....	83,469
Stoneware and chemical ware.....	5	.....	311,208
Sanitary ware and plumbing fixtures.....	5	.....	792,619
Floor, faience, mantel, hand made tile.....	31	.....	796,260
Conduit pipe.....	4	2,111	42,901
Ground fire clay and high-temperature cements...	11	2,815	37,914
Sewer pipe.....	8	21,153	427,188
Art pottery.....	5	.....	109,953
Miscellaneous.....	15	.....	313,248
Total.....	....	.....	$4,125,651

Certain types of colloidal clays, commonly referred to as bleaching clays, decolorizing clays, or absorbent clays (sometimes as bentonite) are produced in quantities in and near California. They are extensively used for decolorizing and neutralizing in the refining of petroleum, and in the treatment of vegetable and animal oils and other industrial liquids. In California, these clays are generally designated as montmorillonite, hallosite, otavite, or shoshonite, depending upon the locality in which they are produced. Some of these clays, particularly those from the vicinity of Death Valley, are naturally active as color absorbents, and have been successfully used after a simple drying and grinding operation. Other clays of this type require treatment, usually with acid, to develop in them a sufficient capacity for absorbing coloring material.

Some highly specialized and efficient products have been developed and marketed by California producers, although the greater bulk of the production is by or for the larger oil refineries. Otavite is mined in quantity near San Diego, activated by treatment with sulphuric acid, and used either as a wet sludge, or as a dried powder in decolorizing petroleum products by the contact process. In addition to the California production, raw and partly prepared clay materials are shipped into the Coast cities from the states of Arizona, Utah and Nevada.

Colloidal clays, sometimes called "rock soap," have been used in many other ways, and have interesting possibilities. One of the important uses is for addition to oil-well drilling muds to improve viscosity and suspending quality. Other uses are in emulsions, as fillers in paper, cloth and linoleum, in paints, cosmetics, and "beauty muds," for sealing irrigation ditches and earth reservoirs, for de-inking of paper, in concrete, detergents, water softeners, and as plaster retarder.

According to the Division of Mines of California, in 1934, there was 6,168 tons of bentonite type clays produced that had a value of $69,321; production was from seven properties, located in Inyo, Kern, San Benito and San Bernardino counties. In past years the production has been much greater, as illustrated by the year 1928, when 53,323 tons having a value of $501,743 was produced.

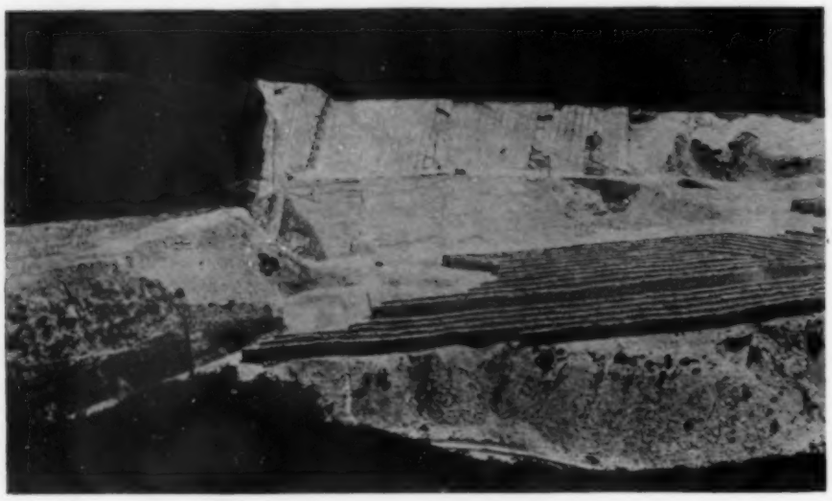
The production of diatomite is almost a California monopoly, since it has represented from 75 to 90 per cent or more of world production for many years.

Today highly specialized diatomaceous earth products for every variety of clarification and filtration, for heat insulation, for fillers, and for many other uses, are manufactured by closely controlled mechanical and chemical processes, in costly though efficient processing plants. The principal plants in California are located in Santa Barbara, Los Angeles, and Monterey counties.

In 1910, the production was only 2,000 tons, but had increased to 130,000 tons in 1929. Restricted industrial activity during the last five years has greatly reduced the amount of diatomite

production, which from the best obtainable data appears to be about 75,000 to 85,000 tons per year. Because of the wide variety of products made from diatomite, and the wide spread in selling prices of these products, little weight can be attached to the figures. The largest market for products is in the manufacturing centers of the East and Middle West, so that to the user, one large item of cost is the transportation. This does not hold for West Coast processing industries, which enjoy much lower delivered costs on their filtration, filler, and heat-insulating products. The possibilities of expansion in uses, and the improvements in quality do not seem to have been exhausted, and probably depend upon the continuation of intensive research for new uses, to which may be ascribed the successful progress of the industry thus far.

Diatomaceous earth or diatomite is found in hundreds of deposits in Coast states, but this one at Lompoc is undisputedly the most extensive source



Insecticides and Fungicides

By E. R. DE ONG
Consulting Entomologist
San Francisco, Calif.

TO ATTAIN the high standard of quality necessary for export markets, the fruit and vegetable industry has greatly stimulated the development and use of all types of insecticides and fungicides. The industry has now reached the volume of approximately $8,000,000 annually, divided into several groups as are indicated in the following compilation which has been drawn from many sources.

Arsenic is the leading product forming the basis for sprays in all large apple and pear orchards, and for cotton and other crops. Lead arsenate, produced from litharge, is manufactured locally and also imported in large quantities from the eastern manufacturing centers. Calcium arsenate for western needs is produced almost entirely at local factories. Magnesium arsenate, used as a substitute for lead on account of poisonous residues, is now being tried extensively. Besides tree sprays, large amounts of arsenical weed killers are produced locally and also shipped from the east. For the latter, crude white arsenic is largely used, coming from Texas, Utah and also imported from Japan and France. Litharge used locally originates at Tacoma, Wash. Copper for the manufacture of sulphate and carbonates is shipped in part from Texas and also from Montana. Organic combinations of copper, which originate in the East, are now being used because of their solubility in oils. Fluo-silicates, especially those combined with barium and sodium, as well as natural and synthetic cryolites, are increasing in consumption, supplementing the arsenical salts to a certain extent. Much of the cryolite is imported, while eastern supplies of fluorine are used as a basis for manufactured fluorine salts in this country. Zinc sulphate and oxide are having a rapid increase in consumption during the last few years, the supplies being largely drawn from the eastern states, the only local manufacturing process being grinding and blending.

The Texas sulphur fields are the chief source for crude brimstone which is milled or sublimed locally and used for dusting, soil and bleaching purposes. For dusting work, only the most finely ground sulphur is used, together with sublimed sulphur, both of which products give large surfaces and good adhesion. Local supplies of rather low grade sulphur are produced in Inyo County and other points of California and also Utah. The latter amounts to only about 15 per cent of the total consumption. Precipitated sulphur recovered in gas purification was developed locally a few years ago but the original supply was interfered with by the natural gas development. However a supply has later been developed for special needs in sulphur dusting. Large amounts of sulphur are also used locally in the making of lime-sulphur solution, carbon bisulphide and sulphur dioxide.

Petroleum oil both for dormant and summer spraying of orchards has been developed to one of the major insecticide industries during the last few years. For summer use, only oils of a higher degree of refinement have been safe, these being marketed either as emulsions or in the "soluble oil form." Local supplies of oils are used for these with manufacturing done locally. Refined pine oils originating in the Gulf states are being used in increasing amounts in the petroleum oil sprays and alone for specific purposes. Fish oils for use as spreaders and as adhesives, and in soaps are produced from local supplies of sardine waste and the dog fish. Castor oil is used to a small degree in the sulphonated form as an oil emulsifier.

Nicotine, both in the free form and in different acid combinations, maintains a steady consumption for both orchard and truck crop work. All material is imported from the eastern states but small amounts coming in from Russia. The form of shipment is either as free (alkaloid) nicotine for combinations in sprays and dusts or as nicotine sulphate and oleate for use alone. Derris extract, principally rotenone, is having an increasing use together with the powdered root itself of the derris plant. The commercial source of supply is the species *Derris elliptica*, imported principally from the British or Dutch East Indies. The plant cubé (*Lonchocarpus nicou*) originates in tropical South America. Another source of rotenone now being investigated is an American plant known as "Rabbit Bean" or "Devil's Shoestring" (*Cracca virginiana.*) The ground dusts are blended with suitable carriers, while rotenone extract is used both in prepared sprays and dusts, such manufacturing being done largely locally. Pyrethrum extract, forming

the basis of fly and hopper sprays, is now also one of the major items of insecticides. Imports of the pyrethrum flower and concentrated extract are drawn almost entirely from Japan.

Hydrocyanic acid gas is the basis for all citrus fumigation, the consumption being almost entirely in southern and south central California. The cyanide salt is imported from the eastern states, principally as sodium cyanide, and at local plants conversion is made into liquid hydrocyanic acid gas, a convenient method of application for orchard work. Calcium cyanide in dust and flake form is also largely used for field and warehouse fumigation. Besides orchard work, large amounts of carbon disulphide are used in squirrel fumigation, weed killers and warehouse treatment. For the latter uses other combinations are now being prepared on account of less fire hazard, which include carbon tetrachloride, ethylene oxide, ethylene dichloride, chloropicrin and sulphur dioxide. In part, supplies of the latter group are manufactured locally although much of it is imported from eastern states.

Paradichlorobenzene maintains a small, steady market for borer control. Betanaphthol is being used in increasing amounts for chemical tree bands. Formaldehyde has a limited use as a fly poison and compounded with a dust basis for greenhouse work. Very recently synthetic insecticides, principally of the thiocyanate type, have been developed and show promise of filling a large field much as do the synthetic chemicals used in the fertilizer trade. The supplies thus far are imported into the Coastal region from the eastern states.

Manufactured Gas and Coke

EDITORIAL STAFF SUMMARY

ON THE PACIFIC COAST, manufactured gas operations are confined largely to Oregon, Washington and British Columbia. In California, the rapid extension of natural gas pipe lines into every major industrial community and to many of the smaller cities and towns has so captured the market that active manufactured gas production facilities are now less than one billion cu.ft. annually. These facilities consist of small, scattered units serving various communities, none of which offer industrial gas rates. The change from manufactured to natural gas in California, the discussion of which will be found elsewhere in this issue, has not eliminated the huge production facilities for manufacturing gas that were formerly used in the large cities. These plants, although shut down, are kept in readiness as standby units to supplement the present natural gas facilities in case of shortage or other eventualities.

In Oregon all gas served at present is manufactured. The largest producer is the Portland Gas and Coke Co. serving the territory in the Willamette River valley from Vancouver, Wash., to Corvallis, Ore. This company, with production facilities of 3,000 million cu.ft. annually, supplies 570 B.t.u. oil gas under a very comprehensive group of commercial and industrial schedules including optional rates for specialized processes such as enameling, metal melting and steam production. Byproducts of its gas production are benzol, oil gas tar, and an excellent grade of pure carbon briquets which are used both for domestic heating in the territory and for water gas production in other communities.

As will be noted from the tabulation, other smaller communities in Oregon are served from small individual plants capable of supplying the limited industrial demands of the surrounding area.

In Washington also only manufactured gas is available. In the industrial area bordering Puget Sound, the Seattle Gas Co. serves Seattle and the Washington Gas and Electric Co. serves Tacoma, Everett, and the Grays Harbor territory surrounding Aberdeen and Hoquiam. In Seattle local coal is coked and the coke used in the water gas plant, the water gas being enriched with oil gas. The annual production of 500 B.t.u. gas is approximately 2,250 million cu.ft. of which 1,500 million is produced in the water gas plants and the remainder from the coke ovens. Plants in the other cities mentioned produce water gas of approximately 500 B.t.u. content using local coal as a basis with oil enrichment. Byproducts of the process are coke and tar.

Rates in this vicinity are low, optional industrial rates being effective for specialized processes. Illustrative is the three-part rate schedule in Tacoma which provides for a commodity charge of $0.55 per M cu.ft. for commercial and industrial users.

In Spokane, the Spokane Gas and Fuel Co. supplies a mixture of water gas and coal gas having a 450 B.t.u. content under favorable industrial rates with the usual optional schedules. Local coal is coked for use in the plants, the capacity of which is about 250,000,000 cu.ft. annually.

In other Washington cities and towns, gas service is provided from small local plants using local coal as a basic fuel. Gas from these plants averages 500 B.t.u. heat content. No industrial rates are on file for these communities although in isolated cases special rates have been negotiated with large industrial users.

British Columbia gas plants at Vancouver and Victoria, having a total capacity of well over 1,000 million cu.ft. annually use Vancouver Island coal almost exclusively and are important for their byproducts which include coke, tar and sulphate of ammonia.

Aside from the larger manufactured gas plants in Oregon, Washington and British Columbia, there are no large producers of coke on the Pacific Coast. Coke, produced as a byproduct of gas manufactured from Washington coal, is

Table I—Manufactured Gas in Pacific Coast States

State	B.t.u. Content	Oil	Coal	Water	Butane-air	Rate
California	550‡ 900†	250,000,000	275,000,000	.....	206,000,000	No industrial rates*
Oregon						
Willamette Valley from Vancouver, Wash., to Corvallis, Ore.	570	3,500,000,000	.....	.....	.....	Among lowest in U. S.
Roseburg-Grants Pass	550	24,000,000	.....	.....	.....	No specific ind. rate
Medford	550	.....	.....	50,000,000	.....	No. specific ind rate
Marshfield	570	10,000,000	.....	.....	.....	60¢/mcf.—low step
Eugene	580	.....	50,000,000	.....	.....	.....
Pendleton	500	.....	24,000,000	.....	.....	60¢/mcf.—low step
Astoria	570	.....	30,000,000	.....	.....	.....
Washington						
Seattle area	500	.....	700,000,000	1,500,000,000	.....	Industrial rates
Tacoma area	507					55¢/mcf.—low step
Aberdeen-Hoquiam	485	.....	25,000,000	550,000,000	.....	No data on specific industrial schedules in these 3 cities
Everett	506					
Centralia	502					
Spokane	450	.....	225,000,000	100,000,000	.....	Competitive ind. rates
British Columbia						
Vancouver-Victoria	465	.....	1,125,000,000	.....	.....	.....

‡Coal and oil gas. †Butane-air gas. *No industrial rates except El Centro, Calif.

used for water gas manufacture and sold for domestic heating due to lack of industrial markets at the present time. While coal deposits in Washington are extensive, the coal does not produce coke of the proper quality for foundry or blast furnace operations although it can be used in less exacting processes satisfactorily.

The nearest supply of foundry coke for Pacific Coast industry is in Canada although foundry coke also is imported into the territory from Europe, the eastern U. S. and Alabama through the Panama Canal. The coal deposits in Utah, Wyoming and Colorado produce a good quality metallurgical coke which is now used in the blast furnaces and smelters of the Intermountain and Pacific Coast states. However, the present production facilities, while capable of supplying large amounts of metallurgical coke for new industrial uses, would not be available when the existing blast furnaces and smelters are operating on a normal basis. On the other hand, coking coal deposits in the Rocky Mountain states are of such an extent that ample supplies of metallurgical coke could be developed should future industrial requirements on the Pacific Coast warrant such expansion of coke-producing facilities.

Lime and Cement

EDITORIAL STAFF SURVEY

FOUNDATIONS for the lime and cement industry in the Pacific Coast states were laid in the Cretaceous period which left huge limestone formations at or near the surface of coast mountain ranges. Abundant supplies of this element together with the presence of suitable clays has made possible, within a relatively few years, the growth of the cement industry until today the production capacity in the three Pacific Coast states is approximately 28,000,000 bbl. annually. This capacity can supply from three to four times the present local demand for lime and cements.

Pacific Coast cement plants are grouped at or in the vicinity of industrial centers. Practically all of them rely upon nearby limestone deposits for raw material but one plant in the Northwest having deep-water facilities found an Alaskan source economical, using company steamers to transport the crushed stone in bulk form to the plant. Another California plant uses the extensive shell beds of San Francisco Bay.

Quality of Pacific Coast cements is uniformly excellent and the variety of special types available for industrial consumption probably exceeds that of other sections of the country. Included in the latter category are the usual "quick-setting" cements, waterproof and plastic cements, as well as two brands of special oil-well cements, one having a high specific gravity and the other suitable for deep-well cementing where high temperatures prevail. Recently made available is a sea-water cement resistant to the action of salt water.

Prices of cement in the various industrial centers of the Pacific Coast vary from $2 to $2.85 per bbl. in cloth sacks. These prices are for carload lots and are subject to 10c. cash discount and 10c. refund upon return of each sack. Within the past few years there has been a rapid growth of "pre-mixed" plants.

Lime in its various industrial compounds is also produced in a wide variety equal to any other section of the country in all Pacific Coast states. The present demand for lime products in the West is only about 40 per cent of the plant capacity. Basic prices are approximately the same as those of Eastern centers, although the freight differential is somewhat higher due to the relatively longer transportation distances.

Availability of abundant deposits of raw materials plus the versatility and capacities of present producers indicate that the lime and cement industry of the three Pacific Coast states can cope successfully with accelerated industrial expansion on the West Coast.

Table I—Cement Plants of Oregon, Washington and California

Company	Plant	No. of Kilns	Annual Capacity (bbl.)	Type of Process
Oregon				
Beaver Portland Cement Co.	Gold Hill	1	700,000	Wet
Oregon Portland Cement Co.	Oswego	2	400,000	Wet
Washington				
Northwestern Portland Cement Co.	Grotto	1	600,000	Wet
Olympic Portland Cement Co.	Bellingham	3	950,000	Wet
Pacific Coast Cement Co.	Seattle	5	3,200,000	Wet
Superior Portland Cement Co.	Concrete			
Spokane Portland Cement Co.	Irvin	2	500,000	Dry
California				
Calaveras Cement Co.	San Andreas	2	1,100,000	Wet
California Portland Cement Co.	Colton	9	4,320,000	Dry
Cowell Portland Cement Co.	Cowell	8	1,440,000	Dry
Monolith Portland Cement Co.	Monolith	4	1,500,000	Wet
Pacific Portland Cement Co.	Redwood City	8	3,000,000	Wet
Riverside Cement Co.	Riverside	19	4,500,000	Dry
Santa Cruz Portland Cement Co.	Davenport	18	3,000,000	Dry
Southwestern Portland Cement Co.	Victorville		2,000,000	
Yosemite Portland Cement Co.	Merced	2	900,000	Wet

Iron and Steel

EDITORIAL STAFF SURVEY

IRON AND STEEL manufacturing operations on the Pacific Coast have grown up solely to supply the demand of Western communities for metal products. From its inception in 1867, when the first small, crude blast furnace was blown in at Oswego, Ore., to the present time the industry has had to dispose of its product in local markets primarily because geographical isolation by the Rocky Mountains made the transportation of iron and steel expensive in the West and acted to prevent Western products from entering the extremely competitive markets of the East.

Early in the history of the development of this region it was known that extensive and high-grade iron ore deposits existed in all three Pacific Coast states as well as in Utah, although only the latter have been worked on a large scale basis. During the industrial development of the Pacific Coast from 1880 to 1920, a number of small companies were organized, each located in or near one of the larger industrial centers and partially supplying the needs of that market. It was these small plants that developed nearby ore deposits, using limestone from the San Juan Islands in Washington or in California.

THE development of iron production on the Pacific Coast has undoubtedly been retarded by the lack of suitable coal deposits in the vicinity of the ore. This condition does not hold in Utah where high-grade iron ore is available near large deposits of a good coking coal.

Steel production on the Pacific Coast is carried on in the four principal industrial areas. The six major steel plants now in operation have an annual ingot capacity of approximately 600,000 tons, from which are manufactured practically any standard structural shape, hot and cold rolled sheets, tin plate, high tensile steels, and wire products. Exceptions are some of the tubular products required by the petroleum industry.. In addition to these major operations, there are a number of smaller companies producing special steels for specific industrial uses on a small scale. Notable among these is the development of special alloy steels for the requirements of the oil industry in southern California and electric furnace steels for the chemical industries, particularly the pulp and paper plants of the Northwest.

EXPLOSIVES

EDITORIAL STAFF SURVEY

THE first explosives company organized, the California Powder Works, was incorporated on Dec. 28, 1861. At this time, and for many years to come, white labor was scarce and hard to retain, so that recourse was had to Chinese help. Saltpeter could only be obtained by direct importation from India and was consequently scarce and high in price. Later nitrate of soda was brought direct from Chile. Before long the output reached 4,000 kegs a month. There was a heavy demand for blasting powder, as the construction of the Central Pacific Railroad was being pushed to completion.

A few years after the foundation of this powder works, the California company began to feel the effect of the demand for dynamite which was being offered by the Giant Powder Company. The owners of the California Powder Works decided to start a dynamite plant of their own, although the Santa Cruz plant continued to manufacture black powder.

Historians of the explosives industry state that the manufacture of dynamite had its beginning on the West Coast. California was a new country full of the spirit of adventure. Industry was on the increase, railroads were being constructed, mining was attracting a great number of people, and the demand for explosives was constantly growing. Alfred Nobel, the Swedish chemist, had invented dynamite. In California in those days was Julius Bandmann, of the San Francisco firm of Bandmann, Nielson & Co., merchants and importers. Mr. Bandmann, through his brother, Dr. Charles Edward Bandmann, a member of the firm of Alfred Nobel & Co., imported some nitroglycerin in 1866 for use in the California mines. Later, when the new explosive had attracted great attention and, presumably upon Bandmann's suggestion, Nobel sent one of his partners, Theodore Winckler, to San Francisco to demonstrate the new dynamite.

Winckler arrived in San Francisco July 24, 1867, and early in August he made three pounds of dynamite at the Judson and Sheppard Chemical Works. On Aug. 10 he demonstrated its action by blasting some boulders on the line of the Bay View Railroad. This three pound lot was undoubtedly the first dynamite ever manufactured and shot in America.

Evidently the demonstration was successful so far as it went, for on Aug. 13 the Giant Powder Co. was incorporated under the laws of California, more than ten months before the American dynamite patent was granted. The contract between the directors of this company and Winckler, acting for Nobel, provided that Winckler should prove the Giant powder to be superior to nitroglycerin and manufacture an experimental lot of 2,000 lb. But before he could carry out these provisions and while he was looking for a suitable site for the plant, he was taken sick on Sept. 8 and died on Sept. 27, 1867, without disclosing the dynamite secret to anyone in California.

On Dec. 24, of the same year, about as quickly as a letter could go to Germany and back, Nobel's second agent arrived in the person of Dr. J. Fuchs, who was to carry out the provisions of the contract Winckler had made and to superintend the erection of a factory. The company leased some property in Rock House Canon where Dr. Fuchs set up a little laboratory. There he made up another sample lot of about ten pounds early in February, 1868.

Work on the factory, which probably did not have more than two or three buildings for all the operations, now went forward rapidly, and on March 19 actual manufacture started. The crew consisted of a nitroglycerin maker, with perhaps an assistant or two, and a few Chinese laborers.

The new explosive aroused great interest among the miners and in the press, and in spite of the high price charged by the Giant Powder Co. ($1.75 a pound), the California Powder Works began to feel the competition with their black powder.

IN spite of everything, the use of dynamite began to be widened more and more. Its nature began to be better understood. Its successful use, its great superiority over every other kind of explosive, began to draw public approval. In the next decade its use had spread widely, and the growing importance of mining, building, quarrying, and lumbering on the Pacific Coast made imperative a continually expanding use.

Among explosives factories on the West Coast today are blasting powder factories located at du Pont, Wash., and operated by E. I. du Pont de Nemours & Co.; the Giant Company at Giant, Calif. (now operated as a division of the Atlas Powder Co., of Wilmington, Del.); the Hercules Co. located at Hercules, Calif. These two are in the vicinity of San Francisco. Dynamite plants on the West Coast include one operated by du Pont at du Pont, Wash., one at Everett, Wash., operated by the West Coast Powder Co.; three in Calif., in the vicinity of San Francisco; one operated by Hercules Powder Co. at Hercules, and one by the Trojan Powder Co., at Robert Station. California Cap Works at Oakland manufactures and sells fuse. The Coast Manufacturing & Supply Company operates a plant at Livermore, Calif. Among new plants is one being built by the Columbia Powder Co. at Frederickson, Wash., and another just completed by the Halifax Explosives Co. at Saugus, Calif.

Tanning Industry

EDITORIAL STAFF SUMMARY

THE total investment in the tanning industry of the Pacific Coast approximates $4,000,000. Three tanning plants are located in Washington and Oregon and thirteen in or near San Francisco.

Products of the Pacific Coast tanneries are varied in kind, comprising several varieties of oak sole leather to meet the requirements of dress shoes, work shoes and logger boots; the upper leathers for these classes of boots and shoes; chrome and chrome-retanned sole leather; belting leather; harness leather in both black and russet; saddle and stirrup leather principally "skirting" for the production of Mexican saddles; chap leather, both bark and chrome tanned; latigo; lace; strap bag and case leather in all substances, grades and finishes; collar leather for horse collars in both bark tanned russet and chrome tanned black leather; tooling calf skin; elk, patent, chrome-retanned and various shoe upper leathers from calfskins, vealskins and cowhides; garment leather, glove leather, wool skins, shearlings, suede and garment sheep in various colors and finishes. In addition, tanners produce a wide variety of splits used for gloves, shoe insoles and waist belts.

Practically all the Coast tanneries are well equipped with the most modern machinery. The basis of the industry is the large domestic supply of hides and skins, the quantity of which far exceeds the tanning capacity. Hence, the Pacific Coast is an export market for hides.

Producers of bark tanned leathers in this territory enjoy a special advantage in the use of California oak tan bark which is peeled from trees growing principally in the northern counties of the state. The principal chemical used by tanners is bichromate of soda which comes from the East Coast.

Only a small part of the product of Pacific Coast tanneries is utilized locally for there is not sufficient manufacturing capacity in leather goods to consume the entire output. The bulk of the production is marketed in Middle West and East Coast centers.

Soap and Silicate Detergents

By ROSS CUMMINGS

Chemical Engineer,
Berkeley, Calif.

SAN FRANCISCO and Los Angeles districts meet to an exceptional degree the location requirements of the soapmaker. Of approximately forty soap factories in the seven most western states, more than thirty are located in these two areas.* Their yearly output has a value of about $21,000,000 with California plants accounting for 95 per cent of the total. California locations afford good transportation to markets in the western states and Hawaii, and ideal working conditions which make for low-cost operation. The necessary raw materials are available within a small radius.

Los Angeles and Berkeley each have plants which are very large, these being branches of firms manufacturing nationally advertised products. The other factories range downward in size to those which specialize on a single product.

For most of the general purpose products a blend of coconut oil and animal fat is the preferred starting point. In fact, the general use of coconut oil is a feature of the Pacific Coast industry.

Since the soap industry is dependent to a degree on coconut oil and specializes in the products requiring it, the imposition of the Federal tax of 3 cents per pound on foreign vegetable oils has caused much uncertainty and readjustment. Collection of the tax began in May, 1934, and a shortage of oil which has developed in the Orient has further increased prices. Because animal fat has not increased in price as rapidly as coconut oil, tallow has partly replaced coconut oil where such a change has been possible without too greatly altering the character of the product.

Caustic soda has been manufactured for some years in the Los Angeles, San Francisco and Puget Sound areas and more recently caustic potash is obtainable from a San Francisco source. Solar evaporation plants on San Francisco Bay provide the whole coast with salt.

Glycerine is recovered only at the larger soap factories, which also in some cases perform this function for the smaller manufacturers. Two dynamite factories in the San Francisco area and one at Puget Sound absorb most of the product.

The western soap industry makes about 7 per cent of this country's product. Its market, containing 8 per cent of the United States' population extends east to the Rocky Mountains and includes Hawaii. The foreign export business is small, about 1 per cent of the California output entering this field. Since the production percentage is less than the population percentage, a deficiency of production is indicated.

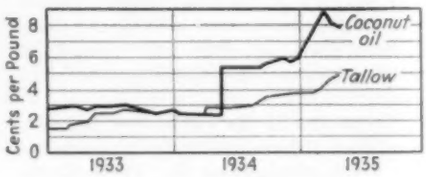
Although sodium metasilicate is not new, the present day interest in this material is largely the result of work by Chester L. Baker of the Philadelphia Quartz Co. of California. Since he emphasized the desirable properties of highly alkaline silicates in industrial cleaning, chemical companies all over the country have taken up manufacture of this material. On the West Coast it is made by two manufacturers.

Silicate of soda is produced in four plants in California, by three manufacturers. Two plants are located in the Los Angeles district, two near San Francisco. The plant capacity exceeds the demand in the district, so the plants operate intermittently. The product goes to the soap and the paper products industry. While most of the market is near the plants, there is a very considerable movement of silicate to the paper and fiberboard mills of Oregon and Washington, probably about 5,000 tons yearly. Only a little export business in silicate now is available, principally to Mexico and Central America. The Japanese market has vanished.

A new market appeared two years ago when it was found that a solution of sodium silicate is effective in removing lead arsenate spray residue from apples. The apple country of Oregon and Washington consumes several hundred tons of silicate for this purpose in the harvest season. However, this market may disappear as suddenly as it came into being, if efforts of the Experiment Stations and insecticide manufacturers to find something other than lead arsenate to combat the coddling moth are successful.

Raw materials for making silicate are soda ash and sand. The California plants use natural soda from Owens and Searles Lakes. Until a few years ago, silica sand was imported from Belgium. When California sand was developed for the glass industry, local sand came into use for silicate also.

Crude oil and low-grade tallow



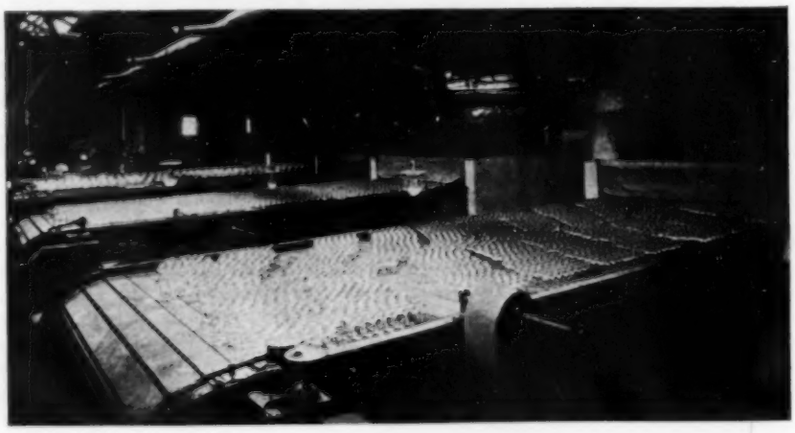
Glass Containers

GLASS manufacture on the Pacific Coast is limited only to containers and small specialty products. Glass containers, which are available in standard stock sizes, are produced in eight large Pacific Coast plants the capacity of which is ample to supply the needs of substantial industrial growth in the territory. As might be expected the producers are located in the major industrial centers, the bulk of the manufacturing being in California.

The Glass Container Association of America lists the following in its West Coast group:

Los Angeles: Owens Illinois Pacific Coast Co.; Latchford Glass Company, Huntington Park; Glass Containers, Inc.; Maywood Glass Co. and McLaughlin Glass Co. *San Francisco:* Owens Illinois Pacific Coast Co. *Oakland:* Hazel Atlas Glass Co. *Seattle:* Northwestern Glass Co.

Battery of three electrically heated glass lehrs in plant of Owens Illinois Pacific Coast Co.



*Soap plants are located as follows: Nevada 1, Utah 1, Oregon 3, Washington 4, California 33.

Western Fertilizers

By R. S. McBRIDE

Editorial Representative, Chem. and Met. Washington, D. C.

WESTERN chemical industry has already contributed pioneer results in the production of fertilizer materials. Some of these have been based on the advantage inherent in having novel mineral supplies provided by nature. Other parts of the pioneering have been those dependent on new technology. In addition to the anticipated natural growth of the industry, further new developments are to be expected in this area. Some of these depend on mineral resources, others on cheap power at tidewater.

Potash production in the United States on any scale significant with reference to demand has occurred only in the West. The pioneer in this development was, of course, American Potash & Chemical Corp., processing the salt brines at Searles Lake. More recently the two potash mines at Carlsbad, New Mexico, have added significantly to domestic potash supply. In the aggregate these three western enterprises could, in case of emergency, take over the full responsibility for supplying the United States with potash in quantities adequate for both agriculture and industry. And, thanks to good chemical engineering, the price would not need to advance materially.

The interesting and novel feature of the Searles Lake development has, of course, been the adaptation of physico-chemical methods with precise control of plant conditions for the separation of the mixed salts found in nature. The most striking feature of the development at Carlsbad thus far has been the core drilling exploration. On the basis of that inquiry, partly private, partly Governmental, two mines of substantial capacity are producing both sylvite and polyhalite. The former, without chemical processing, is available for full usage. The latter still requires substantial new development work in order to give efficient and economical conversion to usable forms of chemicals.

Early in the history of synthetic ammonia development in the United States, Great Western Electro-Chemical Co. installed a small unit for the utilization of byproduct hydrogen. That plant has, however, served essentially only the chemical users of ammonia. Not until a larger plant was built by the Shell Oil Co. did synthetic nitrogen products enter importantly into western fertilizer making. The Shell plant near Pittsburg, Calif., is interesting not so much for its technology as for the fact that it is the first example in America of the use of byproduct refinery-still gas in the manufacture of hydrogen to be used in the production of synthetic ammonia.

The Shell enterprise is of special interest to the chemical engineer as the first American manufacturer of synthetic ammonium sulphate.* It has also made a striking development, peculiarly western in type, for the use of anhydrous ammonia by discharge directly into irrigation water. By this scheme the water flowing on to irrigated land becomes the ammonia carrier, without the requirement of any acid or other solvent medium. Substantial success has attached to this development in the few areas where it has thus far been applied.

Two western metallurgical enterprises confronted by smelter-fume problems have in large measure solved their difficulty by recovery of sulphuric acid and the manufacture of superphosphate. At Anaconda the difficulty of remoteness has been offset by the production of triple superphosphate, carrying from 45 to 50 per cent by weight of plant food.

At Trail, British Columbia, we find a different type of development in which new technology has striking interest for the chemical engineer. At this point there has been ammonia synthesis by the Fauser process and the first development of the Dorr-Liljenroth process for the manufacture of superphosphate by this novel wet process. (See *Chem. and Met.*, Nov., 1931, p. 626 ff.)

Out of approximately 75 fertilizer plants in the western states only four, in addition to those already mentioned, make superphosphate. Three of these establishments manufacture their own sulphuric acid. The other operates with purchased acid. Thus the majority of the western fertilizer industry is made up of relatively small establishments which are largely dry-mixing plants operating on purchased raw materials. This perhaps is not strange in view of the fact that the fertilizer market of the West is still relatively small, and because of the great distances, is widely scattered. It does seem somewhat strange, however, that out of the so-called "Big Seven" companies in the industry who do business throughout all of the eastern, southern, and central states, only one, Swift & Co., is represented in the far West.

Table I—Fertilizer Materials Used on the Pacific Coast

Tonnages reported to National Fertilizer Association for fertilizer year 1933-34 (Estimated 70% for Calif., 85% for Oregon, 95% for Wash.)

	California	Oregon	Washington	Total
Sulphate of ammonia	22,900	1,260	2,600	26,760
Superphosphate	3,550	970	1,520	6,040
Calcium nitrate	4,050	75	35	4,160
Ammo-phos	3,265	40	60	3,365
Lime	2,965	90	105	3,160
Bone products	1,240	1,020	780	3,040
Gypsum	2,949	1	....	2,950
Nitrate of soda	1,850	225	325	2,400
Potash salts	360	440	450	1,250
Other inorganics	480	....	....	480
Total	43,609	4,121	5,875	53,605
Chicken manure	21,850	....	....	21,850
Fish meal	5,050	250	600	5,900
Tankage & sewage	2,360	5	1,300	3,665
Other manures	2,350	230	560	3,140
Dried blood	1,000	24	40	1,064
Cottonseed & other meal	318	....	92	410
Miscellaneous	270	30	42	342
Total	33,198	539	2,634	36,371
Grand total	76,807	4,660	8,509	89,976

Table II—Western Fertilizer Survey

Data from National Fertilizer Association

	Fertilizer Consumption (Estimated Tonnage)	Complete Mixtures (Per Cent of Total Tonnage)	Nitrogenous Chemicals (Per Cent of Total Tonnage)	Superphosphate Sold as Such (Per Cent of Total Tonnage)	Average Composition All Fertilizer and Fertilizer Materials Sold N	P_2O_5	K_2O
Montana	20	..	..	..	10½	10½	..
Wyoming	....	..	..	..	..	..	..
Idaho	500	17	75	1	20	3	5
Colorado	800	47	42	10	11	10	2
Utah	....	..	..	..	..	..	..
Nevada	500	..	..	..	5	11	4
Arizona	800	1	38	60	7	12½	0
New Mexico	1,000	..	4	96	1	20	0
California	137,200	17	31	4	11	7	2½
Oregon	9,000	37	21	13	6½	11½	6
Washington	15,000	37	21	11	7½	8½	5
West. total	164,820	20	29	6	10	7	3
U. S. total	5,580,000	70	9	11	4½	9	4½

*A large plant installed for this purpose at Hopewell, Va., has never operated. —EDITOR.

The habit of fertilizer use in the West is quite different than in the East. In these states large tonnages of "simples" are used. This means that the fertilizer user there employs the simple fertilizer materials individually, and does not ordinarily use mixed fertilizer. Where mixed fertilizer is employed formulas entirely strange to the East are often applied.

Further advance in the fertilizer industry of the West is bound to come, partly through general growth in the area, and partly through the fact that virgin fertile soils cannot be indefinitely cropped without greater fertilization than is now practiced. But to the chemical engineering industries the greatest opportunity probably lies in the fact that processing for export seems a logical development of the early future.

When the Bonneville Dam has been completed very low-cost power will be available at tidewater. Processing of phosphates and the preparation of concentrated mixed fertilizers at this point is a logical expectation. Not only are the large deposits of phosphate in Idaho and Montana available; there is also always the possibility of using phosphate rock brought to the plant by water at low water freight rates even from such remote points as Florida. Mountain state producers of phosphate may not like this thought; but unless rail freight rates are adjusted to meet the situation, it may actually prove to be a fact that Florida rock can be put into a furnace at Bonneville cheaper than rock hauled over two mountain ranges by rail from Montana.

As one looks westward from these Pacific ports tremendous opportunity for supplying fertilizer in the Oriental market is at once evident. Japan has, to be sure, become substantially self-sufficient in nitrogen synthesis. But there is no expectation that a like self-sufficiency can be obtained with reference to either phosphate or potash. Preparation of these two important fertilizer constituents for export may, therefore, prove to be the greatest opportunity of chemical engineering applied to the Western fertilizer business of tomorrow.

PAINT AND VARNISH INDUSTRY

By P. D. BUCKMINSTER

General Superintendent,
General Paint Corp.,
San Francisco, Calif.

THE manufacture of paint and varnish in the Pacific Coast states differs from the manufacture of these products in other sections of the United States in so far as economic conditions favor the use of local raw materials and as climatic conditions necessitate the development of special products with increased protective properties.

A Pacific Coast manufacturer of paint and varnish with a personal knowledge of his local climatic conditions is much better qualified to understand and to service the particular requirements of the actual consumer in his own section of the country than an Eastern manufacturer with a national distribution of a common line of products formulated to meet the general requirements of the entire country. This fact is made evident from a consideration of the different climatic conditions found not only in adjacent states such as California and Oregon but in different sections of one state; as in the cool, moist climate of the San Francisco Bay region, the hot, dry climate of the San Joaquin Valley, the colder climate of the mountain sections among the High Sierras, and the arid conditions of the desert regions of southern California. Then there are the different requirements occasioned by different types of building construction peculiar to this part of the country.

It is therefore fortunate for the industry that natural trade barriers have favored local manufacturers and that the paint and varnish products as formulated and manufactured on the Pacific Coast have been developed principally for local consumption. It is quite natural then for both practical and economic reasons that these products are not shipped to Eastern markets in any appreciable volume. On the other hand, the coast manufacturers are particularly well qualified to service all types of marine business and export requirements in Alaska, Mexico and the Hawaiian Islands, also in Japan, China and other parts of Asia as well as Australia, the sum total of which results in a favorable volume of business.

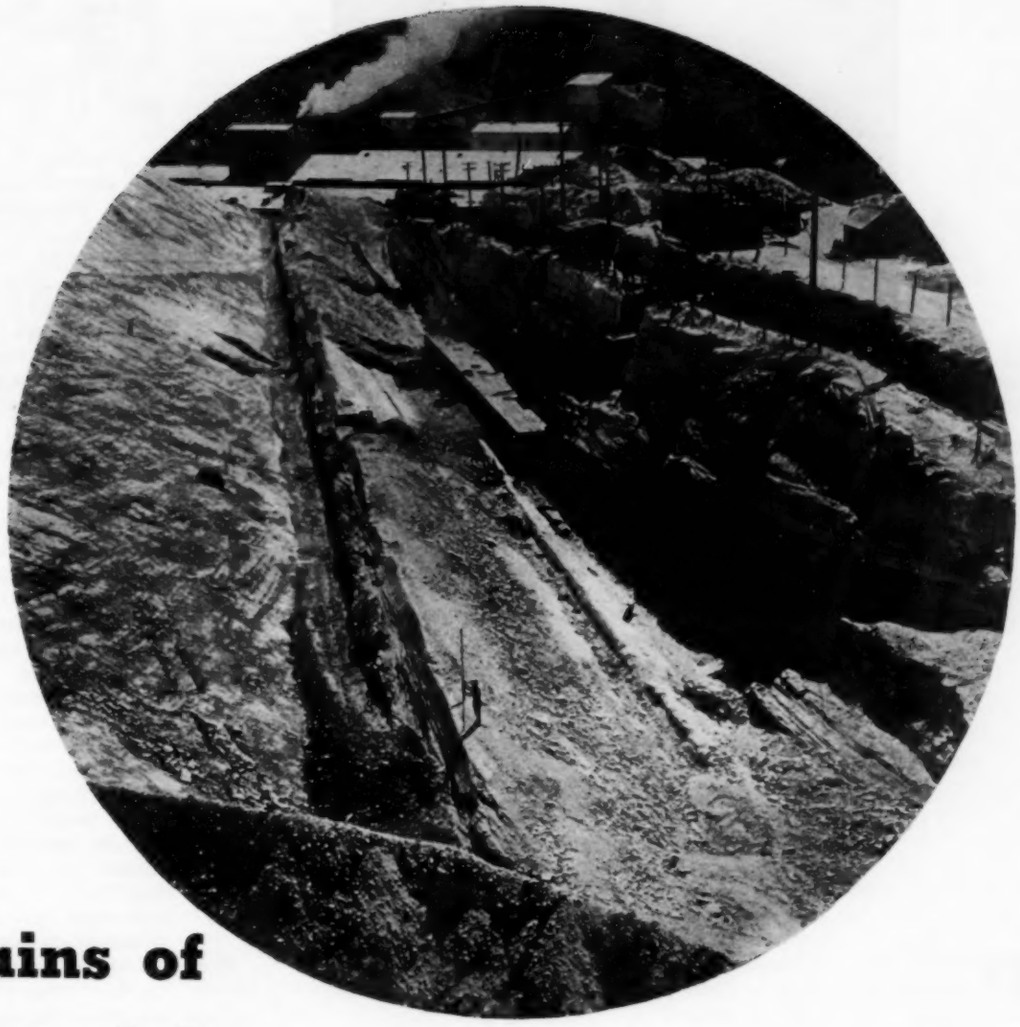
Manufacturers of paint and varnish on the coast naturally use some raw materials which are different from those used in other parts of the country. Distance from the primary source of American turpentine and rosin favors the use of Mexican products to some extent. Mineral spirits, which is the common turpentine substitute, is an aliphatic hydrocarbon and differs somewhat in its properties, depending upon its source, that is, whether it is derived from a petroleum or an asphalt base. The common paint thinner in the Eastern and Central states is derived from a petroleum base, but the mineral spirits used on the Pacific Coast is taken from local asphaltic sources. There are no other distinct differences in raw materials except in the inert pigments such as asbestine, silica, talc, and so forth, mined in California, which vary considerably from the corresponding pigments used by the paint and varnish industry in other sections.

Linseed oil is produced in both California and Oregon. The paint and varnish manufacturers on the coast have an advantage in direct deliveries of China wood oil, perilla oil, soya bean oil and hemp seed oil from the Orient, also a limited quantity of walnut oil and raisin seed oil in California, while refined sardine oil is available at a most favorable cost.

White lead is produced in California by both the Old Dutch process and the Carter quick process and until recently zinc products have been available from Canyon City, Colorado. Lithopone is, also, manufactured in California and there is one large dry color manufacturer, also one or two manufacturers of synthetic iron colors. However, with these exceptions practically all paint, varnish and lacquer materials are shipped into the Pacific Coast states by Eastern manufacturers.

The Bureau of the Census has recently issued its final report of paint and varnish production in 1933. The 961 manufacturers in the United States reporting in 1933 had an output valued at $289,442,000. There were 84 manufacturers in California whose production was valued at $16,405,000; nine in Oregon with a production total of $656,000, and eight in Washington with a total of $561,000.

An analysis of these figures will show that while 10.5 per cent of the total paint and varnish manufacturers in the United States are located in the Pacific states they make only 6 per cent of the total paint and varnish produced in this country. When consideration is also given to the fact that many Eastern manufacturers of paint and varnish products maintain large offices and warehouses on the Pacific Coast with extensive sales organizations it becomes evident that this is a highly competitive industry particularly in this part of the country. There is not much tendency to specialize but those local companies which maintain an efficient staff of trained chemists and follow a definite research development program are able to meet the full requirements of their trade and also make some creditable contributions to the industry both in improved products and methods of manufacture.



Mountains of Raw Materials

LITERALLY out of the mountains of the West have come whole new industries such as those producing the useful diatomite and ceramic clays or the versatile barite and borax. Other raw materials, whether from farm or factory, from sea or forest, are available in sufficient quantity and variety to supply almost any conceivable requirements for the process industries of the future. Some of these are surveyed in the following pages.

Ingots of barium oxide from the electric furnaces of the Modesto plant of Barium Products, Ltd. are the largest ever produced

BARITE

In Abundance

By W. N. WILLIAMS

California Chemical Co., San Francisco, Calif.

OUTSTANDING among the new developments of the past few years affecting the Pacific Coast barium industry has been the return of the barium peroxide process for manufacture of hydrogen peroxide. The sharply increased use of hydrogen peroxide in industrial bleaching processes has resulted in an encouraging hum of activity at the Modesto, Calif., plant of Barium Products, Ltd.

The National Pigments Co. of El Portal has maintained its position as the largest consumer of barite on the Pacific Coast. The chief product turned out at El Portal is a mixture containing a very high percentage of ground barite which is used in oil-well drilling to prevent escape of gas and oil when well-casings are being placed. National Pigments has also recently introduced a barium sulphate-barium carbonate mixture which is now being extensively used as a flux in glass manufacture.

The Chemical and Pigments Co., of Oakland, Calif., continues to make progress in the manufacture and sale of lithopone and related pigments. Bleached barite is also an important product of the Oakland plant.

A limited amount of white barite ore is ground for use as a pigment or filler by several custom grinders. The three plants previously mentioned however, constitute practically the entire barium industry of the Pacific Coast at the present time. Based on Eastern standards, the industry is not a large one. The total consumption of barium ore by all Pacific Coast producers of barium products during 1935 will probably be of the order of 35,000 tons, and the value of the finished products made from this ore will not exceed $1,500,000. Approximately 250 persons are employed by the industry.

A plentiful supply of low-cost barium ore in California and neighboring states constitutes one of the chief reasons for the confidence displayed by Pacific Coast producers of barium products in the continued growth of their industry. The deposit operated by the National Pigments Co., at El Portal, has been producing ore since 1910 and undoubtedly will continue to produce for many years to come. The ore consumed at the Modesto plant of Barium Products, Ltd. is mined in Plumas County. The Chemical and Pigments Co. has recently opened up a very large barite deposit near Battle Mountain, Nev. Substantial reductions in freight rates from Nevada points into California have enlarged tremendously the ore reserves available to California producers of barium products.

The barite used in the mixture produced by the National Pigments Co. for use in oil-well drilling is prepared by grinding the crude ore to 300 mesh and water-floating to remove silica and other impurities. After drying and screening, the finely divided barite is incorporated into the finished mixture which is then sacked for shipment. This product is marketed chiefly in the California and Texas oil fields, although a substantial tonnage is exported. The glass flux compound produced at El Portal is marketed throughout the United States.

The lithopone, titanium pigments, and ground barite produced by the Chemical and Pigments Co. are all marketed on the Pacific Coast. The Oakland location of the company's plant is advantageous as regards availability of the main raw materials required in its operations, namely barite, zinc concentrates, petroleum coke and sulphuric acid.

The products manufactured by Barium Products, Ltd. are barium peroxide, hydrogen peroxide, barium carbonate, barium hydrate, blanc fixe and sodium sulphide. The major portions of all of these products except barium peroxide are consumed in the West. Part of the barium peroxide manufactured by Barium Products is converted to hydrogen peroxide at Modesto to supply Pacific Coast demands for industrial and U.S.P. grades of this latter product. The balance is shipped East for conversion into hydrogen peroxide by several manufacturers. A large tonnage of Modesto barium peroxide is shipped to the Carteret, New Jersey, plant of Westvaco Chlorine Products, Inc., and converted into hydrogen peroxide for sale to textile concerns and other industrial bleachers who are situated in that section of the country.

Because of its unusual history, barium peroxide is perhaps the most interesting of the products manufactured at Modesto. Commercial production of barium peroxide in this country was begun in 1915 to take care of a growing demand for hydrogen peroxide for industrial bleaching and pharmaceutical purposes. The new industry prospered for a time, but as the merits of hydrogen peroxide as an industrial bleach became more generally known and its use rapidly increased, the barium process gradually lost ground to competitive processes. The recognized high quality of the hydrogen peroxide made from barium was not sufficient to offset its high production cost, except in the pharmaceutical field where purity and stability were of paramount importance. Major process improvements

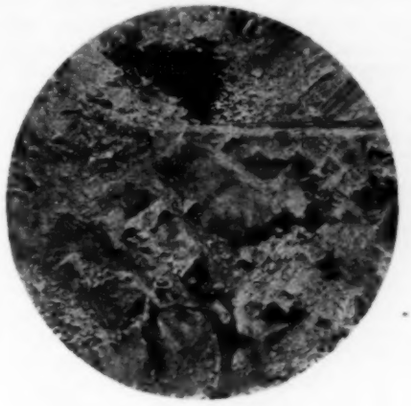
made within the past few years, however, coupled with plant locations favorable both to manufacturing and marketing, have now made hydrogen peroxide produced from barium available to industrial users at prices comparing favorably with those quoted by electrolytic producers. These developments have brought about a rather remarkable increase in the consumption of hydrogen peroxide made by the barium process. Perhaps the fact that certain features of the process employed by Barium Products are not employed elsewhere in the United States, might alone justify the following brief description of Modesto operations:

Barite ore is converted to a soluble form of barium by the usual method of roasting with carbon to form barium sulphide. Barium sulphide solution is then treated with soda ash obtained from near-by natural brine lakes. Barium carbonate is thus precipitated and is subsequently filtered from the sodium sulphide solution which is also formed during the precipitation process. The sodium sulphide is concentrated and finds ready outlet in the tanning and mining industries and in other markets.

Part of the barium carbonate produced at Modesto is sold as such, the balance being converted to barium oxide in electric furnaces. The final step in the Modesto process is the treatment of barium oxide with purified air under carefully controlled conditions, to form barium peroxide.

Conversion of barium peroxide to hydrogen peroxide consists essentially of the interaction of barium peroxide and sulphuric acid, blanc fixe being obtained as a byproduct which is sold principally to the rubber, ink, paint and paper trades. A U.S.P. grade of hydrogen peroxide results from this reaction, and is sold as 25-volume concentration to industrial users, or diluted for sale to bottlers of medicinal and toilet grades. Exactly the same materials are used in the preparation of both pharmaceutical and industrial grades of hydrogen peroxide from barium.

Barite mine in Plumas County, Calif., which supplies Modesto plant of Barium Products, Ltd.



Salt and Bromine

By PAUL A. GROSS

Production Manager, California Chemical Co., Newark, Calif.

THE CLIMATE of California is responsible for the production of most of the salt in the state. On the West Coast, the combination of trade winds and the long rainless seasons make an ideal combination for its production from sea water. Elsewhere in the United States, beds laid down in prehistoric days or subterranean brines are the source of this material. There are, of course, other sources, such as salt springs and ancient dry lakes in San Bernardino, Inyo and Kern Counties, but their exploitation is handicapped by unfavorable working conditions, dirt included in the salt crystals, and contamination in some cases by undesirable impurities, such as arsenic.

Salt is a low-price commodity and distribution is governed to a large extent by transportation costs. Prices on the Coast are regulated by the cost of importing Spanish or Bahamian Turk Island salt as ballast.

Solar evaporation of sea water requires large acreages of low-priced tidal lands in a favorable climate, preferably near the consuming market. Except in locations favored by local markets, to be profitable it must be produced in large tonnages. This has led to a consolidation of a great many of the producers and consequently 80 per cent is produced by two companies on San Francisco Bay. This location has all the above-enumerated requirements and in addition the essential feature of possessing a clay soil which makes tight ponds.

These solar plants have been adequately described at various times in *Chem. & Met.* Essentially the process consists of advancing the gradually concentrating sea water from pond to pond, dropping the gypsum before depositing the salt in the final crystallizers. Care must be taken not to concentrate the brines far enough to deposit some of the magnesium sulphate in the salt. The mother liquor, rich in magnesium compounds and bromine, becomes the raw material for the magnesia and bromine plants. About 40 tons of salt are produced to the acre and a year is required to win the salt from the sea water.

California Salt Producers

	Location of Plant	Source of Supply
Alameda County		
Arden Salt Co.	Newark	Sea water
Leslie-California Salt Co.	Alvarado & Mt. Eden	Sea water
Morton Salt Co.	Newark	Arden salt
Kern County		
Long Beach Salt Co.	Saltdale	Lake bed
Los Angeles County		
Long Beach Salt Co.	Long Beach	Sea water
Modoc County		
Surprise Valley Salt Works	Lake City	Alkaline lake water
Monterey County		
Monterey Bay Salt Co.	Moss Landing	Sea water
San Bernardino County		
Burham Chemical Co.	Westend	Lake bed
California Rock Salt Co.	Amboy	Lake bed
Saline Products, Inc.	Amboy	Lake bed
San Diego County		
Western Salt Co.	Chula Vista	Sea water
San Mateo County		
Stauffer Chemical Co.	Redwood City	Sea water

Seventy per cent of the production is marketed as crude salt, 99.5 per cent pure. The chlorine industry of California and the Northwest, fish, hides, and water softening, account for the majority of the tonnage.

Refined salt is produced by dissolving the crude, purifying, and then evaporating in vacuum pans in the usual manner. Household, dairy, bakers, butter making, and canning are the chief consumers.

The output from all sources in California, valued at $1,300,000, amounts to about 325,000 tons, a little over 4 per cent of the production of the United States. About 500 men are employed in its production.

Previous to the development of ethyl gasoline, all bromine in the United States was produced in the Ohio Valley district and by Dow Chemical Co. in Michigan. The total yearly production averaged between 2,000,000 and 3,000,000 lb..

Increased demand for ethylene dibromide for ethyl fluid led the California Chemical Co., who held contracts for the mother liquor from the salt crystallizers of all the larger salt companies, to install a modified Kubierschky tower for the production of bromide, first at the plant of the Western Salt Co. on San Diego Bay and then a major installation at Newark on San Francisco Bay for the bitterns of the Leslie-California and Arden Salt companies.

The bromine content of the bittern varies from 0.12 to 0.20 per cent in different localities and during different seasons. About 90 per cent of the bromine is recovered.

The operation has been described in detail by Seaton in *Chem. & Met.* (vol.

38, p. 638). In brief, it consists of treating the heated, acidified bittern in modified Kubierschky towers with chlorine; condensing the resulting bromine in glass and stoneware coils; removing the dissolved chlorine and organic bromides by fractional distillation in Pyrex column stills.

The c.p. bromine thus produced is sold for chemical purposes, for use in brominators, for sterilization of water, and for manufacturing ethylene dibromide. This last product is prepared by reacting the bromine with ethylene, catalytically produced from ether, in a continuous Pyrex reactor. The crude dibromide is purified by steam distillation and the finished product is shipped in ordinary 55-gal. iron drums, holding 900 lb.

The total bromine production from the plants of the California Chemical Co. on the Pacific Coast is approximately 1,000,000 lb. compared to a total production in the United States in 1933 of about 10,000,000 lb. The Ethyl-Dow sea water plant on the East Coast, which began operation in 1934, produces over 6,000,000 lb.

AMERICA'S BORAX

By GEORGE A. CONNELL

Superintendent
Pacific Coast Borax Co.
Wilmington, Calif.

THE PACIFIC COAST in general and California, in particular, are well blessed with natural resources of borates. There is hardly a county in California in which boron does not occur in some greater or less degree. Likewise in eastern Oregon and Nevada, borate deposits have been found and in some cases worked. However, in spite of this large distribution, an area in the Mohave Desert of California, enclosed in a circle whose radius is only 50 miles, produces, or mines, all the borax made in the United States.

This source is made up of three general deposits, the first being Searles Lake, the second Owens Lake, and the third, the Baker deposit near Kramer in the southeast corner of Kern County.

The borax content of Searles Lake brine is recovered by two companies and by two different methods. The method used by the larger producer, the American Potash & Chemical Corp., is by evaporation and fractional crystallization. The second organization, the West End Chemical Co., produces borax by carbonating the brine and then spray cooling.

The largest producer of borates is the Pacific Coast Borax Co., which mines a mixture of tincal ($Na_2B_4O_7.10\ H_2O$), rasorite—also termed kernite—($Na_2B_4O_7.4\ H_2O$), and considerable insoluble impurities. Because of the impurities the ore has to be refined. Part of the ore is shipped to Wilmington in Los Angeles Harbor for the manufacture of refined borax. The rest of the ore is converted into a semi-pure product by roasting and air classification. This product is termed "calcined rasorite," and contains less water and more anhydrous borax than does refined crystal borax.

The obvious trend in the manufacture of borax is to produce a material having little or no water of crystallization. Crystal borax contains nearly 50 per cent water. Inasmuch as the source of borax is a considerable distance from its point of general use, and since most applications of borax are for the anhydrous product, savings in freight as well as savings in use can be made by removal of water; hence all three companies mentioned are today making some form of anhydrous borax.

Borax has a large number of uses. It is the starting point for making various metallic borates, such as manganese borate, sodium metaborate, sodium perborate, ammonium borate, lead borate, potassium borate and also boric acid. Boric acid is by far the most important in this group.

Borax itself is used in rather large amounts in glass manufacture where its property of lowering melted glass viscosity results in decreased firing temperatures and hence lowered fuel and repair bills. Practically all vitreous enamels have borax as one of their chief constituents; hence borax consumption is to some degree dependent upon the building industries. The new building campaign should help the borax industry.

As is generally well known, borax has antiseptic qualities, and as a result borax is used by tanneries for hide preservation; by fruit packers for mold prevention on oranges and lemons, and is used as well as its acid, boric acid, in various drug products.

Because of its unique property of giving to a water solution a constant hydrogen-ion concentration regardless of its own concentration, temperature and (within large limits) concentration of other constituents, borax is used in the soap, textile, photographic, laundry and glue industries.

Due to these varied uses, it is necessary to furnish consumers with borax in various forms and purities. The largest item by far is "granulated" borax of a mesh size 15 to 50. Besides this, powdered borax, 40 to —200 mesh; crystal borax in lumps of about ¾-in. diameter; "coarse granulated" borax; and the very fine powder termed "impalpable" are sold. The purities range from the "calcined rasorite" with appreciable impurities; through "technical" containing perhaps 0.2 per cent impurities; U.S.P. which is in accordance with the requirements of the United States Pharmacopoeia; and, finally, C.P. Borax containing less than 10 parts per million of total impurities.

The size packages marketed vary from a 50-ton bulk car to a 4-oz. carton, but borax is sold generally in bags weighing 100-125 lb.

As might be expected, the most industrially progressive countries are the largest consumers of borax, thus the United States leads in consumption, well ahead of the other three large users, i.e. Germany, Great Britain, and Japan.

In spite of the various uses of borax, it is recognized that for the economic development of the industry, more and greater uses must be found. In its production from lake brines, borax has been considered as a byproduct. Hence, its volume of production is not dependent upon borax demand, but upon demand for various other heavy chemicals, and its profitable production is dependent upon the price of these products. With the lowering of prices of potash, soda ash, and the like, borax will be forced into the position of the direct product rather than the byproduct, carrying a heavier share of costs and hence a higher price may be expected. During the past six years the various producers have shown practically no profit on their capital.

Sodium Phosphates

By FRED C. BOWMAN

Director of Research
A. R. Maas Chemical Co.
Los Angeles, Calif.

PHOSPHATES are now produced on the Pacific Coast by two firms. The A. R. Maas Chemical Co. of Los Angeles produces a fairly large line of phosphates and Emeryville Chemical Co. of Emeryville, Calif., produces trisodium phosphate on a smaller scale.

The raw materials used are all Western and are available in large quantities. Phosphoric acid is made by the Anaconda Copper Mining Co. at Butte, Mont., as a byproduct of smelter fume recovery and is shipped in steel tank cars. Soda ash is produced by several companies from desert alkali lakes in California. Caustic soda is made both by causticizing desert alkali and by electrolysis of salt.

By far the most important phosphate

salt is trisodium phosphate or TSP. The A. R. Maas Chemical Co. pioneered its Western production in 1928. Consumption sagged during the early years of the depression but has been growing rapidly in the past two years and is now considerably greater than ever before. Only one grade is made, standard crystal. The small Western demand for fines, coarse, globular and flakes is met by importation from the East.

Maas manufactures also a double salt of trisodium phosphate and sodium nitrate known as TSP-N. It is specially adapted for packaging and home use because of its low causticity and non-caking quality. Its consumption is growing rather faster than TSP, increasing 30 or 40 per cent a year. Disodium phosphate is also made but Western demand is quite small as there is no silk industry to consume it. It is used chiefly for softening boiler feed water.

A technical anhydrous TSP has recently been offered but so far the demand is small. It is adapted for water treatment where freight is high or where desert temperatures would melt the crystal TSP in summer. Probably its use will increase as suitable outlets are found. The pure anhydrous TSP is not made in the West; neither is the monohydrate. There is very little demand for either.

Phosphoric acid technical 54 per cent P_2O_5 is used in minor quantities by several industries. No large consumption is in sight.

There is only slight demand for monosodium phosphate, neutral pyrophosphate and metaphosphate and therefore their manufacture in the West is improbable at present. Food phosphates for baking powders and self-rising flours are not made and may not be, as the Western raw materials are not well adapted for the purpose.

Thus the general picture is that of a thriving TSP industry, with several other phosphates produced that are as yet in only modest demand. On the average one new phosphate product is added every two years and then five years is required to market it. Due to strenuous competition with Eastern material the price is very low and the consumers are the principal gainers in the present situation. There is a good probability that the phosphate business of the Coast will increase sharply, perhaps 100 per cent, in the next two years, chiefly because the excise tax on oils handicaps soap, which is the chief competitor of TSP.

ELECTROCHEMICALS

By W. HIRSCHKIND

Vice-President in charge of Research and Development
Great Western Electro-Chemical Co.

CHLORINE is manufactured only by electrolysis; the old chemical processes of Weldon and Deacon have long ago gone on the scrap heap. An economical chlorine manufacturer is, therefore, dependent on at least one, preferably two or three byproducts; namely caustic soda, caustic potash and hydrogen. Two types of electrolytic cells have been developed and perfected largely by American ingenuity, the diaphragm cells such as Allen-Moore, Hooker-Marsh, Gibbs and Vorce and the mercury cells such as the Castner and Whiting. Diaphragm cells are far in the lead. The recent demand for exceedingly pure caustic by the rayon industry caused some alkali experts to predict a revival of the mercury cells, which however, has not materialized to date.

The two principal uses of chlorine are for bleaching and sterilization. During 1934 over 80 per cent of the chlorine manufactured on the Pacific Coast was used for bleaching pulp, the remaining 20 per cent for sterilization and for chemical manufacturing processes. The uses of caustic soda are more diversified, the largest being for oil refining. Other applications are for soap manufacture and in the Coast's canning industries.

Since chlorine can be stored only in relatively small quantities the caustic output of an electrolytic plant depends solely on the ability to dispose of chlorine. For the reason that the uses of caustic soda and chlorine have ordinarily no relation to each other, the Great Western Electro-Chemical Co., some ten years ago, built a plant for causticizing natural sodium carbonate, thereby protecting its caustic customers in case the use of chlorine should suddenly drop off. Today with large over-production of electrolytic caustic such protection is hardly necessary.

The pulp mill units using chlorine for bleaching pulp are rather large and a chlorine consumption of eight to ten tons per day is not unusual. To avoid too great a dependence on a single industry, the Great Western inaugurated, some years ago, a program of diversification, converting chlorine into compounds used on the Pacific Coast or tributary territory.

Bleaching powder has practically disappeared from the market and can no longer be considered an outlet for any quantities of chlorine. However, there is an ever growing use on the Coast for hydrochloric acid and a number of chlorides. Hydrochloric acid is produced in a number of plants by burning chlorine with hydrogen. The coke water-gas chlorination process developed by Great Western in 1922 was replaced after the advent of natural gas by one burning chlorine with natural gas and steam. It requires a volume of natural gas less than one quarter of the volume of hydrogen which would be necessary to produce the same amount of hydrochloric acid.

Zinc chloride was used during and for some time after the War as a substitute for creosote in treating railroad ties. When creosote prices dropped back to normal, most railroads discontinued this use. An interesting new use was discovered, however, in oil refining by Dr. Arthur Lachman of the University of California, who developed the process bearing his name for treating cracked gasolines in vapor phase with concentrated aqueous zinc chloride solutions.

Ferric chloride has found favor as a coagulant for certain water supplies as a substitute for alum. In waters having a high organic content, such as sewage, it is decidedly superior to alum not only as a coagulant but also as a sludge conditioner, giving a denser sludge which is easier to filter. The chemical methods of sewage disposal which are rapidly being adopted in large installations throughout the country depend largely on ferric chloride.

Sodium hypochlorite solutions involving the use of both chlorine and caustic soda are finding more and more use in household and laundry bleaching and sterilizing of small water supplies. Ammonium chloride and zinc ammonium chloride are used as flux and particularly for galvanizing.

Chlorine is used in substantial quantities to liberate bromine from the bitterns of the salt industry of the Pacific Coast. The byproduct hydrogen from the electrolytic cells is used in most electrolytic plants in the manufacture of hydrochloric acid or as fuel. Better returns, however, are obtained by converting it into ammonia which may be sold as such or converted into ammonium chloride by means of hydrochloric acid or into other ammonia compounds such as sulphate, phosphate, and so forth.

In order to further diversify electrolytic production a part of the cells in the Great Western plant are used for manufacture of caustic potash by substituting potassium chloride for common salt as the electrolyte. Large quantities of caustic soda and caustic potash are used in Great Western plant in the manufacture of flotation reagents, principally xanthates.

CHLORINE AND CAUSTIC SODA

By FRED SHANEMAN
Manager,
Pennsylvania Salt Manufacturing Co. of Washington, Tacoma, Wash.

FROM the standpoint of production for sale the eleven Far Western states have three electrolytic chlorine and caustic soda plants and two plants that use lime and natural soda ash for the manufacture of caustic soda. They have a combined producing capacity of approximately 35,000 tons of chlorine and 55,000 tons of caustic soda, on a basis of 76 per cent sodium oxide content. The plants are modern in equipment and design and are well located on the Coast where certain advantages accrue to them in the way of consuming market, raw materials, and shipping facilities.

The Great Western Electro-Chemical Co. operates an electrolytic plant at Pittsburg, Calif. It was built in 1916 by a combination of Eastern and Western capital for the purpose of utilizing available excess power of that section and to exploit the sizable and growing market for caustic soda in the vicinity of San Francisco. This company installed the Allen-Moore electrolytic cell, which is still being used, with certain modifications. In the early days the disposal of chlorine was a problem, and it was shipped principally in the form of bleaching powder, zinc chloride, and muriatic acid. The demand for caustic soda outran that for chlorine, so the necessary equipment was installed to manufacture this alkali from lime and natural soda ash, both of which were readily available. The electrolyte for the Allen-Moore cells also originates close by in the form of sea salt from the water of San Francisco Bay.

Since 1924 the consumption of chlorine in the Western states has improved, principally because of the growth in the pulp industry of the Northwest and the California municipalities' belief in the effectiveness of this element for water and sewage treatment. The Great Western Electro-Chemical Co., therefore, has shown substantial progress, not only in chlorine and caustic soda, but in the production of ammonia, sal ammoniac, xanthates, sulphur dioxide, carbon tetrachloride, and other products with which they have diversified their operations from time to time.

In 1928 the Pennsylvania Salt Manufacturing Co. and the Hooker Electrochemical Co. built plants at Tacoma, Wash. This location was selected because of its close proximity to the chlorine consuming pulp industry and the availability of large blocks of low-priced power. Sea salt is also used by these companies as the basic raw material, and is obtained in bulk via water from San Francisco. The Gibbs electrolytic cell, as developed by the Pennsylvania Salt Manufacturing Co., is used by the first named plant; whereas the modified Townsend cell has been installed by the Hooker company. Approximately 95 per cent of the chlorine produced by these Tacoma firms is shipped to pulp and paper mills and the remainder to miscellaneous consumers such as municipalities, flour mills, swimming pools, etc., scattered widely throughout the Far Western states. The Northwestern states have limited caustic soda requirements, taking less than 15 per cent of the combined production of these two companies. They, therefore, ship the bulk of their output to more distant markets in the form of liquid, solid, or flake. Each concern uses a small amount of its own product in the manufacture of either sodium hypochlorite, muriatic acid, or both.

The Stauffer Chemical Co. operates a causticizing unit at Dominguez, Calif., for the purpose of supplying liquid caustic soda to the oil refining industry of southern California. Only the liquid grade is manufactured from the lime and natural soda ash received from nearby sources. The soda ash has its origin in the concentrated brine of Searles Lake, on which are located the alkali producing plants of the American Potash and Chemical Corp. and the West End Chemical Co.

In the best year these Western states have known chemically, it is estimated they consumed approximately 25,000 tons of chlorine and 36,000 tons of caustic soda. Of the latter some 5,500 tons was supplied by manufacturers not located on the Pacific Coast, thereby reducing the outlets for Western caustic to 30,500 tons. Considering production facilities, there was 28½ per cent idle capacity in the case of chlorine and 44½ per cent in the case of caustic, or about 34½ per cent if the Western plants had supplied the entire 36,000 tons.

The economic status of the chlorine and caustic soda industry of the West is in a state of flux, so to speak. Ability to produce much more than is required is an ominous threat of itself. The pulp mills of Washington and Oregon find difficulty in taking delivery of their anticipated chlorine requirements because of the duty free importations of pulp from Scandinavian countries. New outlets for caustic soda have been offset to a great degree by reduced demand on the part of the oil refining industry. These are serious problems, comparable to those that are doubtless troubling other industries of our country. We hope ours will ultimately find solution in the industrial growth of the West, which was uppermost in mind when the decisions were made to establish the plants on the Coast. There remains one economic problem of more or less importance to the chemical industry at large. Reference is made to the practice of selling excess production in the other fellow's back yard without due regard for prevailing conditions in the particular market or for its limitations. This form of dumping on the Pacific Coast by manufacturers in other sections has been regrettable. Lately it has been accentuated through the use of reciprocity claims by food brokers and chain store firms, which have been appointed jobbers of heavy chemicals.

Soda Ash and Salt Cake

By R. W. MUMFORD
Consulting Engineer
American Potash & Chemical Corp.
Trona, Calif.

CONSUMPTION of soda ash as such for 1934 in Pacific Coast territory was about 90,000 tons, the largest since 1929. In addition a considerable tonnage was marketed in cleansers. The bulk of the consumption is used in the manufacture of glass, chemicals and soap. Consumption will no doubt increase as the population of this area increases.

Salt cake is mainly used on the Pacific Coast in the manufacture of kraft paper. This industry is strongly entrenched in the Pacific Northwest, which is one of the few natural locations for the manufacture of kraft pulp and where its production will continue to increase. Some salt cake finds its way into the manufacture of plate glass. Sodium sulphate in the form of glaubers salts or anhydrous sodium sulphate is consumed in the textile industry. Consumption of all forms of sodium sulphate was about 17,000 tons in 1934, in the Pacific Coast states.

Pacific Coast consumers are unique in that they have a supply of soda ash from natural sources to supply their wants. Owens Lake and Searles Lake in southern California supply 85 per cent of the market requirements. At Owens Lake some trona is harvested and calcined for certain trades. Soda ash is also produced there in large quantities. The soda at Searles Lake occurs in a brine and all shipments from there are in the form of soda ash.

Two plants at Owens Lake and one

plant at Searles Lake are actively producing soda ash by a process which employs carbonation as a means of separating the soda from the other brine constituents. The resulting sodium bicarbonate is filtered, dried and calcined to produce either light ash or dense ash. In case light ash is manufactured first, the dense ash is made from it by a second calcination. Interesting changes from the methods used in the ammonia-soda process have been made to overcome local difficulties.

One plant at Searles Lake is producing soda ash using physico-chemical methods for separating the sodium carbonate from the other constituents of the Searles Lake brine. In this process the carbonate is made direct without passing through the bicarbonate stage.

Sufficient capacity to supply the needs of Pacific Coast consumers exists in the output of the four plants now producing at Owens Lake and Searles Lake. For certain uses a considerable tonnage of soda ash is still shipped in from Eastern ammonia-soda plants. It is reasonably certain that the local producers will in due course produce all grades of soda ash required in this market.

THE desert regions of California and Nevada contain a number of dry lakes or marshes which have served as limited sources of supply for salt cake. This material, except for brief periods, has been a low priced material and high transportation rates to consuming centers have always been a serious handicap to the development of the undoubtedly substantial supplies in these natural deposits. The production of salt cake from natural sources in the United States dropped from 46,539 tons in 1933 to 16,650 tons in 1934, largely because of the suspension of the operations at Camp Verde in Arizona and Rhodes Marsh in Nevada.

Production of salt cake from natural deposits has usually consisted of a mining operation of thenardite deposits. The crude thenardite was washed at relatively high temperatures to free the material from adhering mud. A drying and crushing operation produced a usable salt cake. Production of salt cake by phase-rule methods is actively under way at Searles Lake. Experimental work was conducted during 1933 and 1934 to produce salt cake from the brines of Dale Lake and Soda Lake in California, but none of this material has yet been marketed.

Improvements in the operation of the plants manufacturing soda ash from brines are constantly being made. The supply of sodium carbonate is adequate and the production of soda ash from the natural deposits will be available to meet the needs of the Pacific Coast—for many years to come.

The consumption of salt cake in this area must come from production from natural deposits or from imports of the material. Production of salt cake and nitre cake as byproducts of the manufacture of hydrochloric and nitric acids is small and unlikely to increase; in fact, they may quite logically decrease. A stable production, ample for all needs, has developed at Searles Lake.

SULPHURIC AND NITRIC ACIDS

By DAN S. GREEN
Stauffer Chemical Co.,
Los Angeles, Calif.

PRODUCTION of sulphuric acid on the Pacific Coast has kept well abreast of the consuming market in this region. Well chosen locations for plants have proved economical to both the consumer and manufacturer. Short rail hauls permitting prompt delivery of this chemical are advantageous in many ways, allowing consumers to keep their stocks at a minimum and at the same time aiding the manufacturer of the acid in maintaining optimum ratio of tons of acid handled per tankcar mile.

The San Francisco Bay region and the Los Angeles area have the major sulphuric acid plants and also present the two largest consuming markets. In the San Francisco region sulphuric acid is produced by the Stauffer Chemical Co., Stege; General Chemical Co., Nichols; Hercules Powder Co., Pinole, and by the Mountain Copper Co., Mococo. The first three concerns use the contact method, while the fourth uses the chamber method. The Stauffer Chemical Co., General Chemical Co. and Mountain Copper use sulphide ores as a source of sulphur dioxide gas, while the Hercules Powder Co. uses sulphur from Texas for its raw material. The sulphide ores have their origin for the most part in Shasta County in the northern part of California.

In the Los Angeles area the Stauffer Chemical Co. and the General Chemical Co. operate plants employing the contact method. The General Chemical at El Segundo and Stauffer Chemical at Vernon and Dominguez use sulphur from Texas and Louisiana for their raw material. Water shipments in full cargo lots arriving at frequent intervals keep both manufacturers well supplied.

Other acid plants on the Pacific Coast are located in Washington and British Columbia. The duPont company operates a contact plant near Tacoma, in conjunction with an explosives plant, and the General Chemical Co. has a contact plant at Barnett, B. C. Also the Consolidated Mining & Smelting Co. has a large contact plant at Trail, B. C. Further inland the Anaconda Copper Co. operates a chamber plant at Anaconda, Mont. At Garfield, Utah, the American Smelting & Refining Co. also has a chamber plant, and there is another at Douglas, Arizona, owned by the Calumet and Arizona Copper Co. Also at this same location the Apache Powder Co. produces fuming sulphuric acid for its explosives plant at Benson, Ariz.

As may well be imagined, the petroleum industry affords the principal market for sulphuric acid in the San Francisco and Los Angeles territories. Considerable tonnage is also used by the manufacturers themselves for the production of other chemicals, such as sulphate of alumina, sulphate of iron, sulphate of copper, acid phosphate, boric acid, tartaric acid, and electrolytes. Sulphuric acid used in the manufacture of fertilizer chemicals, namely superphosphate and sulphate of ammonia, will probably rank second to the oil industry in tonnage consumed. The making of alcohol solvents also employs large tonnage as well as the explosives industry. For the most part the acid plants operated by mining or smelting companies find their outlets either in their own leaching operations or in the manufacture of other products, such as phosphoric acid for fertilizer use or other fertilizers. To a large extent the production of sulphuric acid by these concerns is of secondary importance as they are primarily engaged in the production of metals.

Production figures have not been attempted herein, but a conservative estimate indicates that approximately 500 tons per day—100 per cent basis—is produced in the San Francisco area and 400 tons per day in the Los Angeles area. Production in other locations depends largely on metal markets and prices.

Nitric acid is produced by the General Chemical Co. at its Nichols, Calif., plant using sulphuric acid and nitrate of soda. The Hercules Powder Co. at Pinole, employing the ammonia-oxidation method, produces nitric acid for use in the manufacture of explosives. The ammonia used in this process is obtained from the Shell Chemical Co. located at Shellpoint. The Stauffer Chemical Co. operates nitric acid plants at Stege and Los Angeles, using nitrate of soda and sulphuric acid for production purposes. The duPont company, operating in Washington, produces nitric acid synthetically. This acid is also produced by the Apache Powder Co. at its plant at Benson, Ariz., using sulphuric acid and nitrate of soda. By far the chief outlet for nitric acid on the Pacific Coast is in the manufacture of explosives. A small quantity is consumed by the engraving and photographic trade.

IODINE

By PAUL D. V. MANNING
Pacific Coast Editor, Chem. & Met.

THREE PLANTS located in southern California very near Long Beach, are manufacturing iodine from oil-well brines. The capacity of these plants is sufficient to take care of the present requirements of this country. The largest plant is owned by the General Salt Co., financed by California capital as is also the smaller of the three, that of the Deepwater Chemical Co. The third plant is owned by the Dow Chemical Co., Midland, Mich.

The process in use by the General Salt Co. was described in *Chem. & Met.* in November, 1934. It consists in liberating the iodine by acid, adsorption in activated carbon and subsequent removal with alkali, after which the iodine is liberated and refined. The other two plants operate under patents owned by the Dow Chemical Co., and use silver as the combining agent.

Oil-well brines which constitute the raw material are received from an emulsion-breaking plant which removes the oil from waste oil-field waters. This purification plant is operated cooperatively by the oil companies to prevent the pollution of the neighboring beaches with oil wastes.

Iodine is not present in these waters in large quantities, its concentration being very low. The product cannot, at the present time, be produced at as low a cost as Chilean iodine. The production of these three plants, however, has been sufficient to cause the iodine syndicate to lower the price of iodine to less than one third of what was formerly considered normal, in an effort to stifle the United States production. This happened in spite of the fact that the southern California production is not large enough to be any threat in export business.

Given a certain amount of protection in the form of a limited tariff for a few years, the present industry can certainly reduce its costs. It is difficult to compare its costs with those in Chile, since no information is available as to what fixed charges the latter production bears. Iodine production is a byproduct operation in Chile and hence the costs can be set at almost any figure desired by the operators. In addition to this, the operators have the rich profits of many years of high prices during which the monopoly completely controlled the situation.

SOLVENTS

PRACTICALLY all of the usual solvents are being manufactured on the Pacific Coast, largely as the result of a demand from an active and progressive paint, varnish and lacquer industry. Low and high boiling petroleum solvents are made by several of the larger oil companies. They are used as extracting agents, paint and varnish thinners and lacquer diluents.

Carbon disulphide is produced by Stauffer Chemical Co. Aside from that which is used in the manufacture of xanthates, the principal market is in the agricultural industry, where it is widely used as a weed killer and rodent eradicator.

Ethyl alcohol to supply the requirements of the seven Western states is all manufactured in California by the U. S. Industrial Alcohol Co., with a plant at Anaheim, the American Distilling Co. (formerly the American Commercial Alcohol Co.), with a plant at Sausalito and the Commercial Solvents Corp., with a plant at Agnew. Raw material is molasses from the various sugar refineries. Approximately 40 per cent of the output goes to the paint, varnish and lacquer industry, 30 per cent to the beverage industry and the balance is used for cosmetics, pharmaceuticals, etc.

Methyl ethyl ketone, methyl propyl ketone, secondary butyl and amyl alcohols and acetates and benzol are manufactured by the Shell Chemical Co. at its Pittsburg, Calif., plant. Practically the entire production is sold for the manufacture of paint and lacquer.

Producing the Nation's Potash

By R. W. MUMFORD
Consulting Engineer
American Potash & Chemical Corp.
Trona, Calif.

POTASSIUM compounds in the Pacific Coast states are used mainly for fertilizer as is the case in the balance of the United States where approximately 90 per cent of the consumption is for plant food. A considerable tonnage of muriate of potash now enters chemical manufacture for production of caustic potash, which was formerly imported. Total consumption of potash for 1934 was approximately 6,000 tons of K_2O.

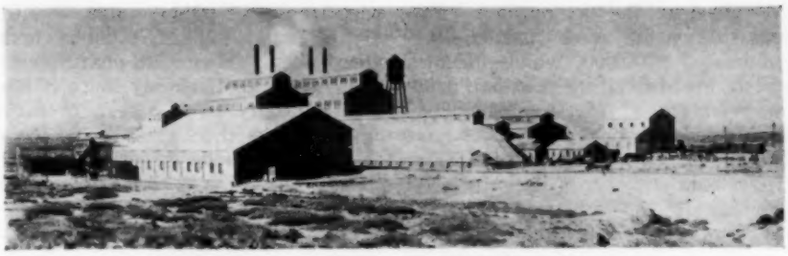
At present the agricultural consumers in Pacific Coast states demand potash largely in the form of sulphate. As in most sections, where land is new, its use in fertilizer is limited. It seems likely that its use will increase as the continued cropping of the limited areas available for cultivation reduces the natural plant food in the soils. As the population of this section increases, there should also be a natural increase in consumption of potash for industrial uses. A very substantial amount of caustic potash is used in the manufacture of flotation agents. Any increase in prices which would stimulate the production of metals in which flotation is used should increase the consumption of potash.

Two centers of production of potash are in or adjacent to Pacific Coast states. Production of high-grade muriate of potash commenced in 1916 at Searles Lake in California and has continued in increasing volume during the ensuing years. Late in 1931 production of low analysis muriate was established in the New Mexico potash field near Carlsbad. By the end of 1932 high-grade muriate was available from this field. The result is shown in a jump in potash production in the United States from 63,880 tons of K_2O in 1931 to 143,378 tons of K_2O in 1933. Since 1933 further increases in capacity for production of high-grade material have been completed at both Searles Lake and Carlsbad. One additional shaft was ready in 1934 to produce low analysis potash. Little was sold, however, because of the low prices obtaining in the United States potash markets. A second refinery is now under construction near Carlsbad.

At Searles Lake the potassium compounds are present in a brine, which is pumped from shallow wells to multiple effect evaporators where its water is removed. The concentrated liquor from this evaporation is cooled to produce 97 per cent muriate. A subsequent refining produces a muriate containing in excess of 99 per cent potassium chloride. Along with the potash are produced borax, soda ash and salt cake.

At Carlsbad a mixture of sylvite and halite, called sylvinite, is mined at a depth of about 1,000 ft. The run of mine ore is crushed, sized and either sent to the refinery or shipped as manure salts. In the refinery the crude potash is hot leached to dissolve its potash content. The resulting hot concentrated liquor is cooled to produce a muriate which analyzes 98.5 per cent or better of KCl.

Except for limited tonnages of potash, produced in Maryland as byproducts of the manufacture of alcohol and cement, all of the domestic production is mined or manufactured in California and New Mexico. Only the muriate is produced and this is in grades running from manure salts containing 25-30 per cent K_2O to the highest grades of refined potassium chloride containing 97 to 99.5 per cent KCl. The muriate is economically available to consumers anywhere in the Pacific Coast territory. The high-



New potash refinery at Carlsbad, New Mexico

grade muriates are the finest potash salts in the world, available to the trade in large quantities at competitive prices. The production capacity is such that any demand for muriate of potash likely to develop in this area, can be met without further expansion.

Production of sulphate of potash has not yet been attempted at Carlsbad or Searles Lake. There have been discoveries of sulphate of potash in the New Mexico field and active efforts are under way looking to its development.

The industry as a whole seems to be in a healthy condition and is well established. Thus the efforts to build a potash industry in the United States, which began in 1910, have borne fruit and it is unlikely that there will ever be a shortage of potash in this country such as existed during the Great War.

Low selling prices and high delivery charges tend to cause the industry to concentrate upon high-analysis products. Prices for potash are the lowest in the United States history. This should materially stimulate its use both in agriculture and in chemical industry.

CERAMIC RAW MATERIALS

By B. M. BURCHFIEL
Director of Research,
Gladding, McBean & Co.,
Los Angeles, Calif.

ANY PERSON who makes a survey of the available raw materials for the ceramic industry on the Pacific Coast will be surprised at his own findings. If he is entirely unfamiliar with the subject at the outset, he will be astounded at the variety of excellent raw materials available from this area. These materials that he finds will not be prospector's samples. He will find them for the most part in deposits of some magnitude, being worked daily. He can also see them consumed by manufacturers who find them entirely satisfactory for products of a high standard of quality.

It has frequently been stated by those familiar with the subject that southern California has a greater variety of usable clays than any other section in the world. Large manufacturers in this area frequently carry in stock as many as twenty to thirty clays, and use them almost continuously. At least 50 separate and distinct clays are available for commercial use. While many of these are owned by the users, a vast variety are available at reasonable prices on the open market.

In the practical, usable clays are included nearly every type from the lowly surface loam to ball clays and china clays, of excellent purity and working qualities. There are several excellent red and buff burning clays and shales which work extremely well throughout the entire manufacturing process. The variety of fireclays is even more extensive. In this group are included plastic clays of a siliceous nature, and clays that are guaranteed to contain over 50 per cent alumina. Many clays of various grades are found between these extremes, of course. Excellent flint and semi-flint fireclays are also produced and used in this area.

Good clays are by no means confined to southern California exclusively. Central California produces and uses some excellent clays, principally of the plastic ball clay type. Washington has extensive deposits of both plastic and flint fireclays, as well as red and buff burning shales and clays which are put to good use by progressive manufacturers.

Nearly all of the feldspar and silica used on the Pacific Coast are mined and ground locally. Talc has long been produced here and sold in the East as well as locally for its various uses. The ceramic business is now consuming talc in increasing quantities, and we believe that without exception, all the talc used by the ceramic trade here is produced in this territory. To the above list may be added the local feldspathic sands and clays that are of a high degree of purity, reasonable in price and uniform. Cyanite and its allied minerals are also mined and used to some extent. Local glass sands are finding increased favor.

Chemicals for ceramic use are produced in increasing quantities on the Pacific Coast. The trade has known Western borax and boric acid long and favorably. Other manufactured products include soda ash, zinc oxide, white lead, litharge and barium carbonate. The raw materials from which these finished products are made come from local deposits, almost entirely.

In addition to all these materials, there are many other usable minerals scattered over this vast area. Those in close touch with the ceramic laboratories here are impressed by the numerous times they must say to a prospector, or owner, "Yes, you have a very good material, abundant in quantity, and of high purity. If we had this available years ago, we would have been using it for years, no doubt. Under existing conditions we do not need it because our process is designed to use other materials.

The value of these varied raw materials was recognized a long time ago, and as a consequence manufacturing of ceramic products has developed to a considerable extent. This growth was somewhat different here than in other sections of the country. Natural barriers confine the industry to a territory that is vast in area but relatively limited as to population and consumption. It therefore was obliged to make a little of everything, but could not, generally speaking, make very much of anything.

During the years of rapid growth the manufacturers here accordingly expanded capacity along these lines in order to meet adequately the demands of the consumers. This move has resulted in a condition that is definitely to the advantage of the consumer. Manufacturers now find themselves with several times as much capacity as they need. Competition is keen in what is very definitely a buyer's market.

As a direct result of this situation, the most progressive manufacturers adopted definite research programs. They have endeavored to place themselves in a position from which they can attempt to accomplish the impossible by giving the architects and engineers exactly what they want for their particular and varied purposes. With a variety of red, buff and white clays, they are able to produce nearly any shade desired in face brick, floor tile, roof tile or unglazed terra cotta. With shales they make paving brick, as well as acid brick that have gone all over the world, literally by the millions. From these materials they also make glazed and unglazed sewer pipe of exceptional quality and strength, which even find some use in acid plants and similar installations.

Local feldspar, silica, china clay, ball clay and talc are going into floor and wall tile of various types. These are gradually invading the eastern markets on their own merits as to quality and

color. The same is true of dinnerware, garden pottery, art ware, electrical porcelain and other products.

In the field of refractories, the variety of raw materials is particularly advantageous. From these it is possible to manufacture exactly the type of firebrick best suited for the user's purpose. The time has finally arrived when local firebrick users realize that they can obtain just what they want from local manufacturers, regardless of the service conditions that must be met. Eastern engineers and designers are rapidly becoming cognizant of the fact that they need not ship firebrick across the continent. In fact, they are frequently quite complimentary in their remarks concerning the quality, workmanship and service they are now obtaining from Pacific Coast manufacturers.

Magnesium Products

By R. E. CLARKE

President
Marine Chemicals Co., Ltd.
South San Francisco, Calif.

ALTHOUGH statistics on the mining and production of magnesium compounds in the United States are compiled by the U. S. Bureau of Mines and published annually in the Minerals Yearbook, there is no separation of figures for any particular section of the country or indication of the importance of this industry to the Pacific Coast.

It is estimated that under normal conditions the industry, which is centralized in California and Washington, would employ 700 persons with an annual payroll of around $1,000,000. The annual sales volume would approximate $3,500,000. The industry since 1929 has been operating at less than 50 per cent of capacity.

Producing Companies

Name of Company	Raw Material	Products
California Chemical Co.	Bittern Magnesite	Crude, caustic and dead-burned magnesite, artificial periclase and magnesium chloride.
Marine Chemicals Co.	Sea water	Magnesium carbonate, oxide, hydroxide (USP and technical), and hydroxide in paste form.
National Magnesia Co.	Magnesite	Magnesia heat-insulating materials.
Northwest Magnesite Co.	Magnesite	Crude, caustic and dead-burned magnesite.
Pacific Silicate Co.	Magnesite	Magnesium sulphate
Plant Rubber & Asbestos Co.	Bittern	Magnesia heat-insulating materials.

A large percentage of the caustic and dead-burned magnesite and artificial periclase is shipped to Eastern markets to be used in the refractory industry, whereas possibly 75 per cent of the production of the other compounds of magnesium is sold on the Pacific Coast. It is estimated that the sales value of the magnesium compounds sold on the West Coast in 1934 approximated $700,000, which includes magnesia heat-insulating material, magnesia refractories, magnesium carbonate, chloride, hydroxide, oxide, and sulphate (U.S.P. and technical). The industries utilizing magnesium products are steel, rubber, paint, ink, food, dry cleaning, sulphur, tanning, textile, miscellaneous chemical, pharmaceutical and cosmetic. Certainly there is ample plant capacity to take care of the requirements of the Pacific Coast for any of the compounds of magnesia for a considerable time to come.

Animal and Vegetable Oils

By PAUL X. SMITH

Durkee Famous Foods, Inc.
Berkeley, Calif.

THAT the vegetable-oil industry of the Pacific Coast in its ramifications reaches almost to the ends of the earth is a literal statement, for it draws on nearly every country in the world, especially on the tropics, for its supply of raw materials. Our Southern states have cottonseed and peanut mills. Along the Atlantic they crush peanuts, a few tung-oil nuts, and some copra. In the Midwest they manufacture soya bean and linseed oils. On the Pacific Coast there are not only some similar mills but also there are here the largest crushers of copra, hempseed, perilla, kapok, and sesame seeds, the largest fish oil plants, and what bids fair to be important crushers of flaxseed.

All this is because the Pacific Coast is nearest the major sources of raw materials in the form of seeds and nuts—the Philippines, South Sea Islands, Dutch East Indies, India, Japan, China, Manchukuo and those other countries where oil-bearing crops thrive. That these foreign supplies are available when our own crops are exhausted, combined with favorable year-round climatic conditions, gives California a great advantage over other sections of the United States, and accounts for the development of the vegetable-oil industry here. Oil seeds and nuts and vegetable oils themselves represent a very important part of the return cargoes of trans-Pacific steamers and contribute to a very important degree not only to the prosperity of the Pacific ports but to the welfare of the United States in general, for every steamship arriving on our coast is a purchaser of our domestic products.

The supply of domestic oils and fats is not sufficient for our country's demands, and this is particularly true in California, where the production of butter, livestock, cottonseed, and other forms of edible fats is entirely insufficient. Accordingly, we must reach out to almost every section of the globe and bring in sesame seed from China, Manchukuo, India, and in smaller quantities from Africa, Egypt, and the Dutch East Indies. Java produces nearly 90 per cent of the world's kapok seed. Olive oil comes from Italy, hempseed and soya beans from Manchukuo, poppy seed from China, while palm oil and palm kernels arrive from the Dutch East Indies and more distant Africa. Flaxseed is imported from the Argentine and India, vast quantities of cottonseed oil come from Japan, with lesser amounts from Egypt, India, Brazil and the Argentine. Copra, because of a discriminatory tax, must all come from the Philippines. And so these nuts and seeds come from nearly around the world.

Much has been said against such importations and in favor of domestic fats and oils, but such claims are born of prejudice or ignorance. To close the door to foreign fats would work a terrible hardship on our people. The domestic production is not sufficient in quantity nor sufficiently varied in quality for our requirements. For example, our state does not raise one-third of the cottonseed oil it consumes in edible form. If it manufactured enough oil, it would simply increase the surplus of cotton. Cottonseed oil can be brought in cheaper by water from abroad than it can by rail from an eastern state which might have a temporary over-supply. The same is true of animal fats, not only in California, but throughout the country, and many thousands of tons of tallow have been brought in from the Argentine. The United States flaxseed crop is insignificant compared with the demand for linseed oil, so we must import flaxseed, notwithstanding a duty of 65c. per bushel, and other seeds which make oil serving the same purpose. To continue down the list would only add strength to the general statement that nature has made the importation of many seeds or their oil contents necessary to our existence.

A few examples might however be given: Perilla and tung nut oil (wood oil) are used as drying ingredients for paint and supplement our supply of linseed oil, but have no place in the edible field. Sesame oil is an edible product and superior to cottonseed oil or lard because resisting rancidity. Effort is

being made to raise sesame seed in California, but unsuccessfully to date, because the seed pods shatter before all the seed ripens. In countries where labor is cheap the seeds are hand picked, but in California attempts are being made to develop a strain of seed which will be harvested by machinery, adding a new crop of great value to the state and an edible oil far superior to most. Palm oil, indispensable to the tin plate industry, is produced in equatorial countries, and no substitute is known for it. Sunflower seed oil is a valuable and important crop in many countries, but not grown in sufficient quantity on this coast to encourage crushing, though it should be developed. Copra, the raw material from which coconut oil is pressed, grows only in the equatorial belt and cannot be produced in this country. There is no domestic product, nor for that matter no satisfactory foreign product, to take its place in the soap industry or confectionery trades. It is entirely noncompetitive with domestic agriculture, nevertheless it is subject to an excise tax which is costing the American people nearly $20,000,000 per annum, all of which is paid to the Philippine government.

In a small degree the oil from culled walnuts and grapeseed is produced in California, for several special purposes. Walnut oil is used in the better grades of paint enamels, while grapeseed or raisin oil, as it may be termed, is used in paints requiring flexibility such as the painting of canvas awnings and chair coverings. When refined, it is employed as a protective coating for seeded raisins, closing the pores against the loss of sugar and preventing insect or other infestation. California might become one of the heaviest flax-producing states in the Union, as the yield per acre, 20-30 bushels, is four or five times that of other parts of the United States. Plans for 1936 indicate that nearly one-third of the United States crop may be grown here, whereas at the present time this country imports nearly 50 per cent of its requirements. Soya beans, a very important crop in the Midwest, have not been successful in our state, but new types are being developed with considerable promise The finest of domestic cotton grows in California, with probably the highest yield per acre, but with this product, as with many of the others, profit depends upon the condition of foreign trade. Our state would derive no benefit from an increased cotton crop unless a foreign market was available. To raise more cotton merely for the seed and oil, which are byproducts, would be uneconomic.

This country has no surplus of edible or inedible fats at the present time nor will it have for several years because of crop restrictions, livestock destruction, and drought, but even if we had a surplus it would not be of a nature which would satisfy our needs. We would still be compelled to look abroad for those products which our climate or our soils make impossible to us, such as certain drying oils, coconut oil, palm oil, sesame oil. When a condition of surplus returns, if it ever does, our only solution will be found in an exchange of trade with those Oriental countries which produce the materials we must have.

Notwithstanding crop conditions, propaganda, foreign trade restrictions, and other unfavorable influences, the oil crushing industry is one of great importance to the Pacific Coast. Including Alaska, there are 96 oil producing plants of various kinds, representing investments of about $25,000,000. Many of these diversify their production, but there are 70 producing fish oil, of which 40 are in California, 17 in Alaska, and 13 in Washington and Oregon, in addition to which there are three floating reduction plants. Three mills in Oregon and Washington crush vegetable seeds and nuts, while 20 such plants, large and small, are scattered throughout California, 10 in the south, 5 around San Francisco Bay, and 5 in the San Joaquin Valley, these 20 mills having a total capacity of 600,000 tons a year. Some run seasonally, others continuously, but the buying of raw materials, processing, and sale of the finished products represent a huge business. In 1934 California crushed 100,000 tons of cottonseed but only 7,000 tons of flaxseed of its own raising. This will be increased to a probable 30,000 tons this year, but cottonseed is expected to re-

Table I—Imports in pounds of vegetable oils and seeds through Pacific Coast ports, 1934

Kind of Oil or Seed	*Los Angeles*	*San Francisco*	*Portland*	*Seattle*	*TOTAL*
OIL					
Kapok Seed Oil	1,288,050	.....	.....	.....	1,288,050
Rapeseed Oil	2,582,890	28,837,347	.....	.....	31,420,237
Palm Oil	5,102,920	3,166,399	.....	.....	8,269,319
Wood Oil	2,552,180	16,913,327	.....	2,202,000	21,667,507
Sesame Seed Oil	960	11,511	.....	.....	12,471
Peanut Oil	49,510	646,185	11,413	.....	707,108
Nut Oils (N.S.P.F.)	3,227,010	820	.....	.....	3,227,830
Perilla Seed Oil	190,500	8,411,590	.....	8,000	8,610,090
Poppy Seed Oil	140	7	.....	.....	147
Coconut Oil	5,071,890	19,853,633	.....	.....	24,925,523
Linseed Oil	580,110	44,535	.....	.....	624,645
Hempseed Oil	400,000	300,200	.....	.....	700,200
Cottonseed Oil	2,549,920	120,000	.....	.....	2,669,920
Soya Bean Oil	.....	462,705	.....	18,134,000	18,596,705
Olive Oil	.....	664,400	.....	314,000	978,400
Sunflower Seed Oil	.....	448,903	.....	.....	448,903
Castor Oil	.....	220,708	.....	.....	220,708
Total Oil	23,596,080	80,102,270	11,413	20,658,000	124,367,763
OIL SEEDS					
Sesame Seed	13,275,071	5,977,100	.....	24,000	19,276,171
Copra	59,837,210	184,581,293	60,709,841	618,000	305,746,344
Kapok	10,041,470	3,760,041	.....	46,000	13,847,511
Rapeseed	501,000	1,730,220	.....	.....	2,231,220
Flaxseed	289,670	20,538,168	3,958,688	.....	24,786,526
Tung Nuts	2,110	.....	.....	.....	2,110
Palm and Palm Kernel Nuts	14,300	1,120,307	.....	.....	1,134,607
Perilla Seed	.....	1,733,278	.....	.....	1,733,278
Hempseed	4,842,020	4,684,687	.....	694,000	10,220,707
Poppyseed	25,660	27,093	.....	.....	52,753
Apricot Kernel	1,590	6,463	.....	.....	8,053
Castor Beans	322,100	.....	.....	2,248,000	2,570,100
Soya Beans	.....	211,059	.....	.....	211,059
Total Oil Seeds & Nuts	89,152,201	224,369,709	64,668,529	3,630,000	381,820,439

Table II—Most important vegetable oils produced on Pacific Coast for edible and technical uses

Oil and Source	*Principal Places Where Grown*	*Uses*
Copra and Coconut Oil	Philippine Islands, South Seas, Dutch East Indies, Africa, Ceylon	Soap, Oleomargarine, Candy, Biscuits, and Crackers, Cleaning and Dyeing, Face Creams, Sprays and Chemicals, Auto Greases, Inks, Nut Roasting, Rubber Industry, Milk Drying
Palm Kernel Oil	Dutch East Indies and Africa	As Above
Palm Oil	Dutch East Indies and Africa	Soap and Tin Plating
Cottonseed and Oil	U. S., China, Brazil, Egypt	Margarine, Shortenings and Compounds, Salad Oils, Mayonnaise, Salad Dressings, Soap
Sesame Seed and Oil	China, Manchuria, India, Egypt, Africa	Same as Cottonseed Oil
Kapok Seed and Oil	Manchuria, China	Same as Cottonseed Oil
Sunflower Seed and Oil	Manchuria and Russia	Same as Cottonseed Oil
Flaxseed and Oil	U. S., Argentine, India	Paints & Varnishes, Linoleums
Hempseed and Oil	Manchuria, China	Salad Oils, Shortenings, Paint, Soap
Perilla Seed Oil	Japan, China, Manchuria	Paint
Rapeseed Oil	Japan, China, Manchuria	Paint, Shortenings, Salad Oils, Soap
Babassu Nuts	Brasil, British Honduras	Same as Coconut Oil
Oiticica Oil	Brasil	Paint
Soya Beans	U. S., Manchuria	Edible Products, Paint, Flour
Tung Nuts and Oil	China, small amount raised in Florida	Paint and Varnish
Castor Beans and Oil	U. S., China	Lubrication, Medicinal
Peanut Oil	China, U. S.	Edible, Margarine

main unchanged. To operate these plants at reasonable capacity compels the importing of nearly 500,000 tons of oil-bearing materials each year. At present, capacity exceeds consumption, but because of the domestic shortage of fats and oils in 1934, resulting from the influences previously mentioned, the current year may break all records for importation. During 1934 the imports into California alone amounted to 313,521,910 lb. and into Oregon and Washington 68,298,529 lb. Table I will show the principal imports by customs house districts.

But this is only part of the picture, for besides the seeds and nuts brought in for crushing purposes, 124,367,763 lb. of vegetable oils were brought into Pacific

(Continued on page 472)

Metal Industries Produce and Consume Chemicals

By GEORGE J. YOUNG
and JOHN B. HUTTL
Engineering and Mining Journal,
San Francisco, Calif.

FROM the days of the Forty-Niners when the lure of gold drew thousands to the placers of California, mining has played an important part in the development of this state. To the adventurous spirit of these pioneers and their direct descendants must also be given much of the credit for the spectacular rise of the great mining enterprises in the adjacent Rocky Mountain states, the large copper porphyry mines of Arizona, Utah, New Mexico, and Montana, the lead and zinc mines of Utah and Idaho, and the gold and silver mines of Colorado and Nevada.

The recent increase in the price of gold and silver has given a new lease on life to many a mine in the Coast states and has brought renewed activity to several deserted camps. Although no spectacular development has taken place, or is likely to occur in a region so thoroughly prospected, the activity has afforded much needed stimulus to business and employment during the period of economic distress from which the country now appears to be emerging. Direct benefits have also accrued to the chemical industries, through increased consumption of explosives, carbide and compressed gases, brick, clay, and refractories, cyanide, lime and soda ash, nitrate, borax, zinc dust and quicksilver, fuel oil and lubricants, flotation reagents, laboratory equipment and chemicals.

The Pacific Coast boasts only two good-size nonferrous smelters, a lead smelter at Selby, and a copper smelter and refinery at Tacoma, both owned by American Smelting & Refining Co. Selby, in addition to lead, silver, and gold, also turns out a small quantity of antimonial lead, antimony oxide, fused zinc chloride, and copper sulphate. A. S. & R. subsidiaries in the San Francisco region also produce bearing metals, solders and other alloys, lead pipe, grid metal, all largely for local consumption. A Bunker Hill subsidiary in Tacoma also makes lead pipe, alloys, and various other finished products.

The remainder of the lead produced in the area is consumed by corroding plants, in the production of pigments. National Lead operates a plant near Oakland, and Fuller Paint Co. one south of San Francisco. Several companies are also making lead-zinc pigments from complex sulphides, and at least one company produces lithopone. Most of the zinc oxide, sulphide and other zinc pigment material originate without the Pacific region. Columbia Steel Co. produces tin plate as well as corrosion resistant copper bearing steel. Metal and Thermit Corp. operates a detinning plant at South San Francisco.

QUICKSILVER is produced in several of California mines, and also in Oregon and Nevada. Part of this production is utilized in the manufacture of fulminate for blasting caps; the remainder is consumed in amalgamation of gold and silver, except for a small portion used in the manufacture of chemicals and for scientific apparatus. A large plating and galvanizing industry offers outlet for metals, metallic salts, etc.

None of the real large copper mines of the country is found in the Pacific Coast states. Iron Mountain Copper Co. produces copper sulphate and carbonate in its leaching plant at Martinez, Calif. Both of these products are sold to the chemical industries, principally for the manufacture of insect spray (Bordeaux mixture) and for smut control. Other copper producers in the state are the Walker mine and mill, an Anaconda subsidiary, and the Engels mine, both located in Plumas County.

The Tacoma plant, in addition to copper, gold, and silver, also produces arsenic and liquid SO_2. Arsenic, which is also made at Midvale and Murray, Utah, and at Anaconda, Mont., is an important raw material in the production of insecticides and in glass manufacture. The Anaconda smelter is an important producer of byproduct sulphuric acid, phosphoric acid, and superphosphate. Other byproduct acid plants are found at Garfield, Utah, and Douglas, Ariz.

Although outside the Pacific area, geographically speaking, brief mention should be made of the large mines and smelters in the Rocky Mountain states. Kennecott, through its subsidiaries, Utah Copper, and the Nevada, Ray, and Chino divisions, operates the large copper mines at Bingham Canyon, Utah; Ely, Nev.; Ray, Ariz.; and Santa Rita, N. M. Flotation plants are maintained at Hayden, Ariz., McGill, Nevada, and Hurley, N. M. Save in the case of the Nevada unit, where a large smelter operates in conjunction with the mill, all concentrates produced are shipped to the A. S. & R. customs smelters at Garfield, Utah; El Paso, Tex.; Hayden, Ariz.; and Tacoma, Wash.

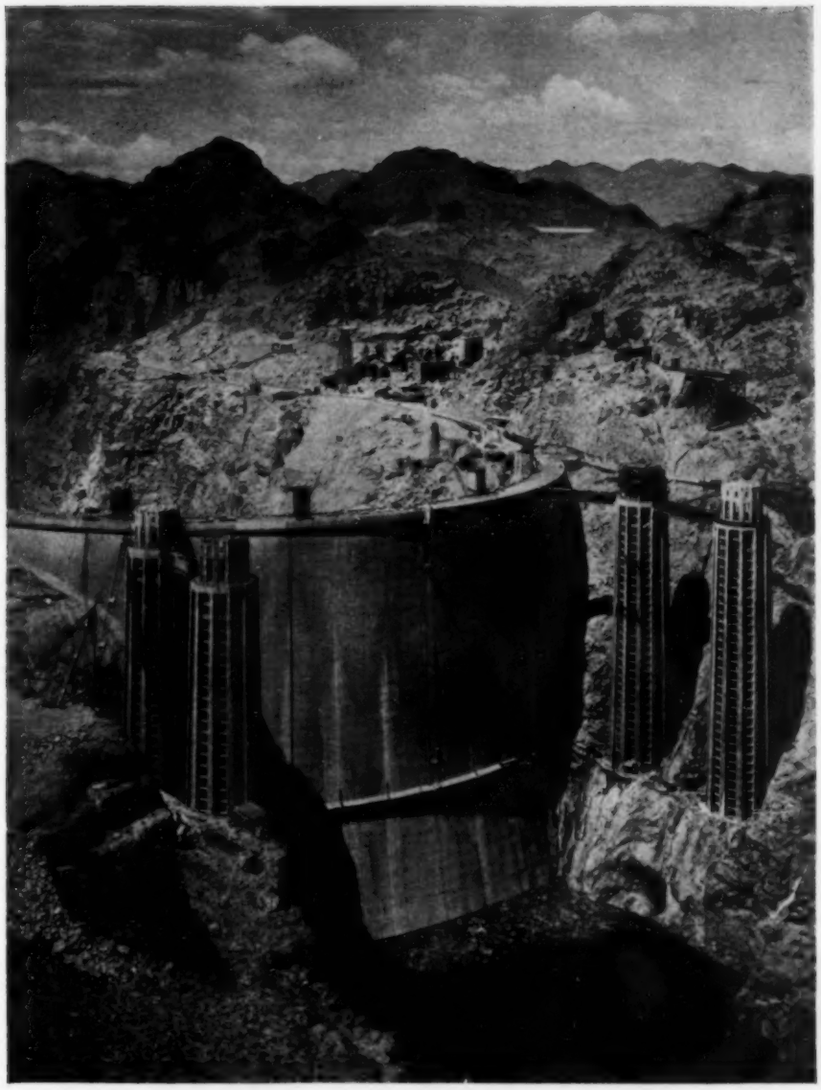
Phelps Dodge operates mines and mills at Ajo, Bisbee, Jerome, and Morenci, Ariz.; Tyrone, N. M.; and Nacozari, Mexico, and smelters at Clifton, Clarkdale, and Douglas, Ariz. Blister copper is either fire refined at Clifton or shipped to the electrolytic refinery of Nichols Copper Co., at El Paso, Tex.

Other important companies active in Arizona include Magma Copper Co., operating mines, a mill, and a smelter at Superior; United Verde Extension with mines at Jerome and a smelter at Clemenceau; Miami Copper Co., and Inspiration Copper Co., both operating flotation mills and leaching plants at Miami. Concentrates produced in the Miami sector are treated at the Miami smelter of International Smelting Co., an Anaconda subsidiary which also operates a custom smelter at Tooele, Utah, and has made important contributions in the metallurgical development of the complex lead-zinc ores of Utah.

The principal Anaconda plants, however, are in Montana, and include 36 mines at Butte, a flotation plant, a smelter, and an electrolytic zinc plant at Anaconda, and a copper refinery, a rod and wire mill, and an electrolytic zinc and cadmium plant at Great Falls. A little farther to the west we find the large lead smelter of Bunker Hill and Sullivan, at Kellogg, Idaho, which also includes an electrolytic zinc and cadmium plant.

Selective flotation had its inception in the Rocky Mountain plants, and here it has found its greatest field of application. The remarkable results achieved through the scientific study of this process, and the introduction of numerous new flotation reagents, some of highly complex chemical structure, have added large tonnages to the country's useful mineral reserves; recent developments are giving definite promise of applications of still greater importance to the process industries.

More Power to Process Industries



POWER is one of the most abundant of the Pacific Coast's many basic raw materials awaiting use in process industries. As a fluid, mobile resource, the West's hydroelectric power is capable of being stored yet is available at such time and place as industrial development may dictate. To the far-sighted chemical engineer, cheap power, adequate transportation facilities, favorable fuel and water supplies and vast natural resources offer the attractive prospect of profitable exploitation.

WEST COAST

SURPLUS of goods, commodities, or services results in a buyer's market. Such is the situation on the Pacific Coast as regards electric power. Two factors contribute to this condition: First, the resourcefulness of an industry that has planned its capacity to meet future requirements on the basis of anticipated growth which the depression years failed to produce. Second, a program of federal reclamation, navigation, water and power development. In this latter category fall Boulder Dam on the Colorado River and the Bonneville and Grand Coulee projects on the Columbia River, a trio of power sources capable of an ultimate 14,500,000,000 kw.-hr. in a region long noted for its cheap electric power.

To the prospective industrial user of electric power the Pacific states offer many distinct advantages, due not only to the surplus of power resources, but also to the physical set-up of the serving utilities. This is primarily a region of hydro-electric energy. In most cases power sites have been remote from load centers. This has resulted in the construction of a network of high tension lines that make power available at almost any point where natural resources or other considerations dictate plant location. Hydro generation means large supplies of both primary and secondary power at low rates. No section of the country can offer available power at lower prices than those prevailing in this region. This is particularly true where conditions permit location of the industrial user close to the generating facilities. At Bonneville on the Columbia River this advantage can be combined with a site on tidewater. This proximity of power resources to both rail and water transportation holds for other sections of the region as well. An important economic factor is the necessity for marketing the power to be produced by the federal projects, either through the existing serving utilities or through agencies which might be set up in the shape of government bureaus. The undesirability of this latter course is certain to have a bearing on the attitude and policies of the present distributing agencies.

IN the determination of plant location, factors other than electric power will usually dictate a final selection, because any power facilities and power rates can be duplicated in almost any locality in the region. Lack of industrial markets, which forced the early utilities to seek other outlets for their power, has resulted in a degree of domestic and agricultural electrification unequaled elsewhere in the country, and in a network of distribution and transmission facilities which are interconnected from the Mexican to the Canadian borders and eastward into Montana, Idaho, and Utah.

At the beginning of 1935 the three Pacific Coast states had an installed capacity in generating stations of 4,141,935 kw., of which 2,627,610 kw. was in hydro-electric plants and 1,514,325 kw. in steam-electric or other fuel-consuming stations. The hydro-electric resources of the three states are estimated by the U.S.G.S. as 15,203,000 hp. on a 90 per cent basis and 23,823,000 hp. on a 50 per cent basis. During 1934 the operating utilities produced 12,276 million kw.-hr. and the 1935 production for six months has averaged approximately 5 per cent higher. Present capacity, ignoring the Bonneville, Grand Coulee, and Boulder Dam projects, will produce an estimated 3,369 million kw.-hr. surplus of firm power. Ultimate development of the federal financed plants will provide an additional 14,500 million kw.-hr. to be developed in steps beginning in 1936 and extending to about 1950.

Various physical characteristics of the existing electrical facilities are shown in greater detail in the accompanying map and table.

Because population, industrial development, markets and distribution facilities for the Pacific Coast states divide the area into certain natural geographic regions, the power resources will be treated in the same fashion.

Puget Sound Region: With its harbor facilities, timber resources and its proximity to Alaska and the Orient, this district is served by three utilities, the Puget Sound Power & Light Co., operating in Seattle and blanketing most of western Washington, the Seattle Lighting Department, and the Tacoma

POWER TYPIFIES

ECONOMICS OF ABUNDANCE

By GEORGE C. TENNEY
and C. W. LEIHY
Editor and Engineering Editor, respectively, Electrical West, San Francisco, Calif.

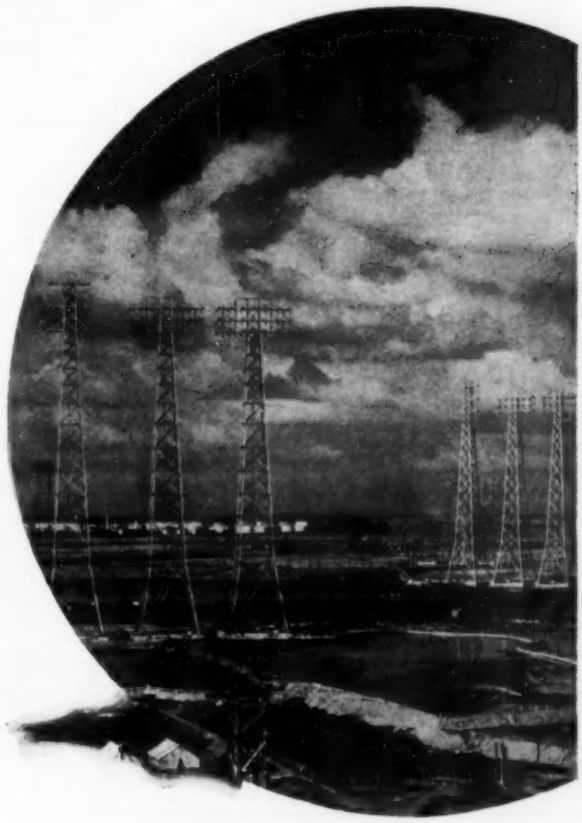
Utilities Department, these latter two serving their respective cities. These three operate primarily hydro plants, although each has a certain capacity of steam. Available generating facilities total 598,000 kw. with an annual output capability of 2,360 million kw.-hr. Present net use is about 1,281 million kw.-hr. and a return to peak load conditions (1930) would show a net of 1,586 million kw.-hr., leaving a surplus of 776 million kw.-hr.

THERE are other factors which assure an adequate supply of electric power in this area without considering imports from either the Grand Coulee or Bonneville projects. Low investment additions may be made to existing stations of all three of these utilities. These include 130,000 kw. at the Baker River and Rock Island plants of the Puget Sound Power & Light Co. and 27,000 kw. to the Cushman plants of Tacoma. In the case of the Seattle Lighting Department 120,000 kw. is being installed in the Diablo plant on the Skagit River and the potential resources of this stream will permit the future addition of 686,000 kw. or an amount in excess of the present total capacity of the entire Puget Sound region. With these available resources there is little likelihood of either power shortage or importation from Grand Coulee and Bonneville, both of which are within economical transmission distance.

Eastern Washington: This area, the center of which is Spokane, has vast timber and agricultural resources, includes the northern Idaho mineral-producing region and is adjacent to the southeastern British Columbia metallurgical and chemical developments. The principal serving utility is the Washington Water Power Co. Installed capacity totals 204,000 kw. and output capability is 930 million kw.-hr. Present net use is 588 million kw.-hr. annually, about 70 million kw.-hr. below the peak load conditions of the pre-depression era. Available surplus is 272 million kw.-hr. in excess of peak demands. Additional capacity requiring low investment may be developed in existing generating stations in this region, the principal site being at the Chelan plant of Washington Water Power Co., where 48,000 kw. can be installed to meet any new power requirements.

What effect the Grand Coulee project on the Columbia River will have on this area is problematical. Designed primarily for the purpose of irrigating a large section of the Columbia basin, the development was started in 1934 as a part of the PWA employment relief program. Power will ultimately be an important byproduct, although, at present, the potential energy available at the dam site awaits favorable load development and will not be utilized for the time being. However, the plans for this project contemplate low cost additions of generating capacity when load demands dictate.

Grand Coulee is by far the most



To the prospective industrial user of electric power Pacific states offer many advantages due to surplus of power resources and to the physical set-up of serving utilities

ambitious irrigation and power project yet undertaken by the federal government. It is designed to be the controlling factor in the complete development of the Columbia River, one of the finest power streams in the world, on which an estimated total of 8,000,000 kw. of generating capacity can be installed for an investment that insures very favorable electric rates. This key project is located some 70 miles west of Spokane, near a tremendous natural depression in the high plateau of eastern Washington. At this point a concrete gravity-type dam 450 ft. high and containing approximately 11,000,000 cu.yd. of concrete would create a reservoir of 5,028,000 acre-ft. By installing earth dams across both ends of the Grand Coulee, and pumping from the reservoir behind the dam, a huge artificial lake 23 miles long and from 6 to 10 miles wide would be created from which irrigation water for reclaiming 1,200,000 acres of eastern Washington land could be obtained at a reasonable cost. While irrigation is the primary object of the project, the release of stored waters from the reservoir will produce 7,500 million kw.-hr. of firm power and 4,000 million kw.-hr. of secondary power at Grand Coulee power house. Thus regulated, the flow in the river below the Coulee also materially improves the power potentialities of the other nine power sites, two of which, Rock Island and Bonneville, are now partly developed.

Grand Coulee, conceived largely as a work relief measure, has little to recommend it as an economic self-sustaining project at this time. Under present economic conditions in agriculture, there is little need for 1,200,000 acres additional farm land. The population density in the contiguous area is very sparse, industrial projects few and the possibility of utilizing such large blocks of power defies even the most imaginative mind. Nor could the power output be advantageously exported to the other market areas which, as stated, have abundant power resources.

These unfavorable factors very probably led to the recent announcement that, for the present, the Grand Coulee project would consist of the foundations for both the 450-ft. dam and a power house having an ultimate capacity of 1,650,000 kw. together with a 150-ft. dam which later will be raised to the full height when conditions so dictate. At this point, then, there will be available a tremendous block of energy which can be developed easily and at a low cost by merely adding generating units to the present power house foundations. As Grand Coulee is within transmission distance of both the Seattle and Portland metropolitan areas, its potential output acts as additional insurance for abundant power at permanently low rates for industry in the Pacific Northwest.

Lower Columbia River Region: The area contiguous to Portland possesses resources similar to those in the Puget Sound region, including deep water transportation. The principal operating utilities are the Portland General Electric Co., Northwestern Electric Co., the Pacific Power & Light Co., all with headquarters in Portland. The first two serve in the city itself as well as in the adjacent territory. Power resources are set at 310,000 kw. with an available yearly output of 1,305 million kw.-hr. Present use is at the rate of 923 million kw.-hr. as compared to peak use of 1,089 million kw.-hr., leaving a surplus of 216 million kw.-hr. A portion of the installed capacity is in steam-electric stations which serve as standby and which are unique in that "hogged" fuel or sawmill waste is burned under the boilers. In recent years it has been necessary to supplement this with fuel oil from California.

Omitting the Bonneville project, there is a potential low-cost power development of 160,000 kw. in the existing stations of these utilities, including 25,000 kw. at the Oak Grove station of Portland General Electric Co. and 135,000 kw. at the Ariel plant of Northwestern Electric Co.

Bonneville, one of the trio of federal projects, will ultimately add 2,720 million kw.-hr. of firm and 1,480 million kw.-hr. of secondary power to the resources of this area. This project is located at tidewater 30 miles east of Portland and is the downstream end of the chain of power sites on the Columbia River between Grand Coulee and Bonneville. At the site of the Bonneville project, Bradford Island divides the river channel in two, the power house forming an integral part of the dam across the southern channel. Characteristics of the site are the low head (maximum 64 ft.), limited storage, and tremendous annual flow which varies from 50,000 sec.-ft. to 1,170,000 sec.-ft., averaging 200,000 sec.-ft.

Improved navigation of the lower Columbia and power generation are the two fundamental objects of this project which is being constructed by U. S. Army engineers. As a source of power it is estimated that the ultimate installation of 430,000 kw. will produce 4,200 million kw.-hr. of firm and secondary power annually. The initial installation now being made consists of two 43,200-kw. units having a potential output of 420 million kw.-hr. at 50 per cent load factor. Inasmuch as a large portion of the investment cost is being absorbed as an improvement to rivers and harbors, the fixed charges on power will be very low at the dam site and only slightly higher in Portland.

Other favorable factors enjoyed by the Bonneville project are the navigation facilities which permit cheap transportation of raw materials and finished products. A lock at the dam will permit ocean vessels to continue up the river beyond the power site, thus making direct East Coast shipments available 200 miles up the Columbia River. Furthermore, river boat and barge navigation will be practicable from Bonneville into central Idaho via the Columbia and Snake rivers which opens up a vast area rich in mineral resources, timber, and agricultural products. Direct rail transportation over low passes also brings the resources of the Coeur d'Alene district in northern Idaho and of Utah and other Intermountain states within economic distance.

Two utilities serve the territory between the Portland area and the upper end of the Sacramento Valley in California. Mountain States Power Co. and California Oregon Power Co. operate in central and southern Oregon, a region of extensive timber resources and considerable agricultural development. These companies have adequate power resources in hydro-electric plants on the Rogue and Klamath rivers to furnish service to any prospective industrial users locating in this section. This section exports some power into central California.

Northern and Central California: This region, comprising the Sacramento Valley and a large portion of the San Joaquin Valley as well as the San

Table I—Power Resources of the Pacific Coast States

	California	Oregon	Washington	Total
Installed hydro capacity, kw.	1,742,393	176,484	708,733	2,627,610
Installed steam capacity, kw.	1,169,454	160,470	184,401	1,514,325
Total installed capacity, kw.	2,911,847	336,954	893,134	4,141,935
Potential hydro resources:				
90% dependable peak-kw.	3,435,000	2,734,000	5,330,000	11,499,000
50% dependable peak-kw.	4,980,000	4,400,000	8,400,000	17,780,000
Energy generated 1934, kw.-hr. × 1,000	8,542,815	994,369	2,634,836	12,276,020
Output capability, present capacity, kw.-hr. × 1,000	10,900,000	1,305,000	3,290,000	15,495,000
Additional from federal projects now under construction, kw.-hr. × 1,000	4,330,000	2,720,000	7,500,000*	14,550,000
Total capability of existing plants incl. federal projects, kw.-hr. × 1,000	15,230,000	4,025,000	10,790,000	29,045,000

*Grand Coulee high dam—foundations only at present.

Francisco Bay area and the northern mountain and central coastal counties, possesses a variety of resources, industrial, mineral and agricultural, as well as deep water transportation as far inland as Stockton on the San Joaquin River. The two major utilities are the Pacific Gas and Electric Co. with headquarters in San Francisco and its subsidiary, the San Joaquin Light & Power Corp., at Fresno.

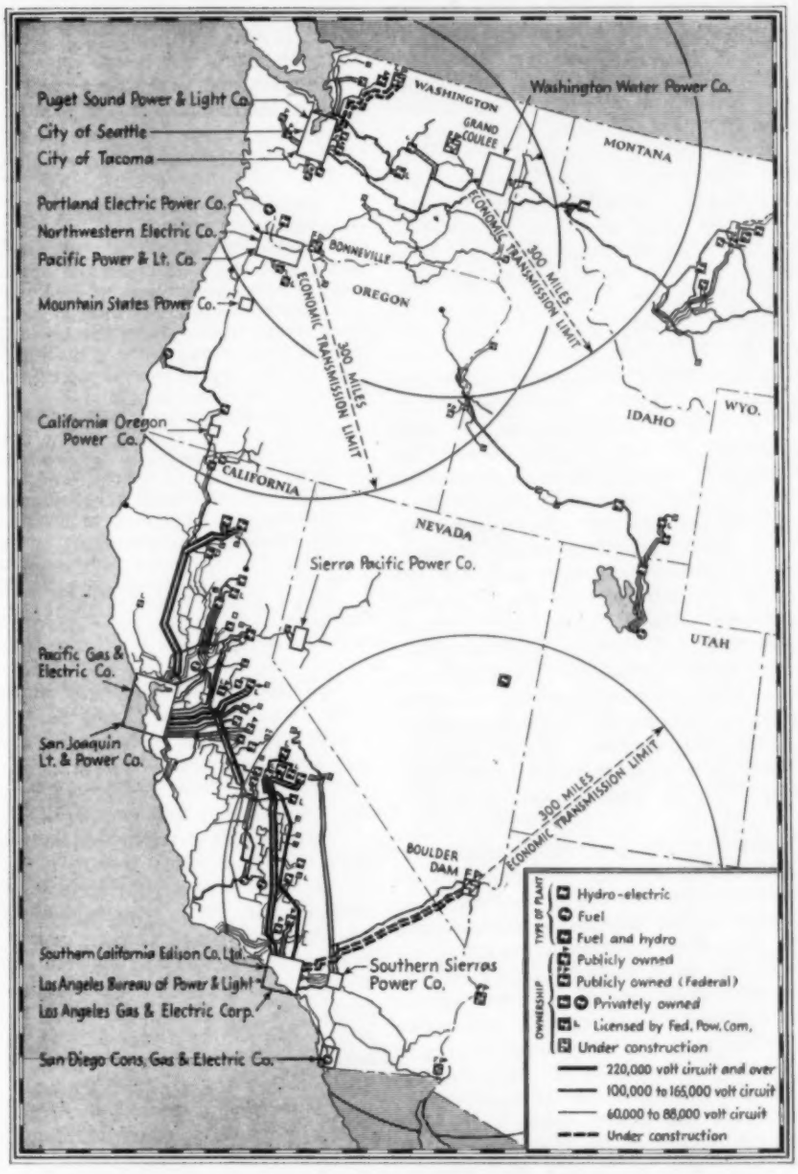
Proximity to large supplies of fuel oil and natural gas changes the complexion of the sources of power from those in the Pacific Northwest. Steam generation competes favorably with hydro. Developed power resources consist of 1,040,000 kw. in hydro stations, for the most part on the rivers flowing down the west slopes of the Sierra Nevada, and 360,000 kw. of steam-electric stations close to the load centers. However, the hydro stations carry the principal base load, the steam plants being brought into service to meet peak demands and as standby in the dry seasons.

The stations comprising this total of 1,400,000 kw. have an output capability of 5,600 million kw.-hr. in dry years as compared to a present usage of 4,600 million kw.-hr. and a demand on the basis of maximum load conditions (1930) of 4,800 million kw.-hr. Thus there is an immediate surplus of nearly 1,000 million kw.-hr. in dry years and more than 2,000 million kw.-hr. in a normal year.

Low cost reserves to the extent of 8,800 million kw.-hr. of firm power can be developed to augment the present power resources of this region. Of this amount approximately 400 million kw.-hr. is in existing hydro stations and would require roughly 150,000 kw. of steam capacity, capable of producing an equal number of kw.-hr., to put it in the firm power category. The balance, in excess of 8,000 million kw.-hr. would be divided between steam and hydro, the latter being installed on the Pit, Feather, Bear, and Mokelumne rivers where extensive projects capable of augmentation are already in service.

In addition the $170,000,000 Central Valley project, involving flood control, water conservation, and byproduct power may at some future date be undertaken by the state or the federal government. This project will be located at Kennett on the Sacramento River and will be capable of producing 260,000 kw. with 1,560 million kw.-hr. To make this firm power an installation of at least 400,000 kw. of steam capacity capable of generating 1,500 million kw.-hr. would be required.

Southern California: To serve the requirements of this area there is a network of power lines extending from the Sierra Nevada to the Mexican border and shortly to be supplemented by the first of a series of lines from Boulder Dam. The major serving utilities consist of the Southern California Edison Company (operating at 50 cycles), the Los Angeles Bureau of Power & Light, and the Los Angeles Gas and Electric Corporation, with headquarters in Los Angeles; the Southern Sierras Power Company at Riverside; the San Diego Consolidated Gas and Electric Company at San Diego, and the municipal utilities of Pasadena, Glendale, and Burbank.



Power map of the Pacific Coast showing the principal generating plants and high voltage transmission lines as well as the various utilities operating in the area. Distribution feeders from this network of high voltage lines interconnect the entire territory so that abundant low-cost power is available for industry practically in any locality. The 300-mile circles circumscribed around Bonneville, Grand Coulee and Boulder Dam show that most metropolitan centers on the Pacific Coast are within economical transmission distance of one of these Federal projects

Developed power resources, ignoring for the moment Boulder Dam, consist of 1,373,989 kw. of installed capacity of which 669,789 kw. is hydro-electric and the balance steam, made with natural gas and/or oil. These resources have an output capability of 4,600 million kw.-hr. Present use is 4,150 kw.-hr. annually and peak use (1930) was 4,300 million kw.-hr. The 300 million kw.-hr. surplus above this peak normally would be appreciably larger because additional capacity would have been required had not the Boulder Dam project

been initiated. Not taking the Dam into consideration, some additional capacity could be added economically through the installation of hydro units on streams now partially developed. However these would require additional steam capacity in corresponding amounts. Tremendous fuel resources of this region, oil and natural gas, also would permit the generation of large quantities of power in modern high efficiency steam plants at prices at least equal to the delivered cost of Boulder Dam power.

Output from Boulder Dam will change the entire aspect of the situation in southern California. This project on the Colorado River is located on the Nevada-Arizona boundary 25 miles southeast of Las Vegas, Nev. The 30,000,000 acre-ft. reservoir impounded by the 726-ft. dam will provide flood and silt control for the lower river basin and an abundant supply of water for irrigation purposes and for domestic and industrial use on the densely populated coastal plain of southern California. Ultimately 1,500 sec.-ft. of water from the Boulder Canyon project will be transported from the Colorado to coast cities by the 242-mile aqueduct of the Metropolitan Water District. Power will be transmitted to the coast over 275-mile transmission circuits.

ALTHOUGH the project originally was scheduled to meet the load requirements in southern California at the time of its completion, the depression has advanced the date when additional generating capacity in the area is necessary so that complete utilization of the power output from Boulder Dam probably will not be possible until 1950 according to present estimates of load growth. In the meantime the 1,000,000 kw. of installed capacity in the power house (scheduled for completion of the ultimate capacity in 1940) will be capable of producing 4,330 million kw.-hr. of firm power and 1,500 million kw.-hr. of secondary power annually. This amount of energy added to the present generating capabilities in the southern California area of 4,600 million kw.-hr. indicates a surplus over and above load requirements for the next 15 years, which will reach a maximum of 1,600 million kw.-hr. and then decrease until 1950 when additional generating capacity will be required.

The entire output of Boulder Dam has been already contracted for with various utilities operating in southern California at a price of 1.63 mills per kw.-hr. for falling water, the charge being made whether or not the companies use their water allotment for power generation. This fact will tend to force the disposal of excess power in this territory and should pave the way for favorable commitments to new industries.

For those industries in which electric power is one of the important basic raw materials, attractive power rates are one of the principal advantages for locating in the Pacific Coast states. Factors influencing favorable costs for large blocks of energy include the following:

1. Surplus production capabilities over existing requirements.
2. Proximity of large hydro-electric plants with the concurrent low production costs of hydro generation.
3. Abundance of cheap fuels in those sections where hydro power must be supplemented with energy from steam plants.
4. Competition of federal power projects in the major industrial centers.
5. Preponderance of loads other than industrial on the existing utility systems with attendant desirability for loads of this character to improve system load factors.
6. The favorable electrical characteristics of process and chemical industry loads which command premium rate schedules.
7. Load characteristics of process industries which permit favorable combinations of firm and secondary or "dump" power, the latter representing utilization of flood waters now spilled.

Typical process and chemical industries now established on the Pacific Coast enjoy rates ranging between 3 and 4 mills per kw.-hr. or $22.50 to $25 per hp.-year. "Waste" power is available as low as 1 mill per kw.-hr.

Analysis of the published rate schedules of the utilities serving this territory, while it is difficult to cite specific comparisons, reveals that power costs are equally low in each of the major market areas. Practically all utilities offer special schedules for heavy industries, lower than their minimum published rates. In the case of process and chemical industries, because of the size of the demand and the load and power factors, rates usually are negotiated by contract, which gives the user the advantage of any favorable characteristics inherent to the individual application. Because the surplus of electric power has given impetus to industrial load building, the prospective user of large blocks of power can expect the utmost consideration and cooperation in securing power costs favorable to his particular process.

To support these statements there is offered a brief review of industrial power costs in the principal market areas of the three states:

Puget Sound Region: Existing chemical and metallurgical plants in this district purchase power at over-all rates ranging from 3.1 to 3.5 mills per kw.-hr. Industrial rates were established with the particular aim of developing heavy industries. For example, for industrial loads in excess of 1,000-hp. demand a flat charge of $2.50 per kw.-month, computed on the basis of maximum demand, is available. "Dump" or surplus power, when available, may be purchased for 3 mills per kw.-hr. or $1.12 per kw.-month. A special rate applicable to electric smelting loads of 1,000 hp. or more carries a charge of 4 mills per kw.-hr. for energy used during December, January, and February, and 3.42 mills per kw.-hr. during the months of March to November inclusive.

Eastern Washington: Available rates in this region are competitive with those elsewhere in the Pacific Northwest. With the eventual completion of the Grand Coulee project, it is anticipated that firm power will be available at rates as low as 2.25 mills per kw.-hr. at the power plant switchboard, with secondary power at 0.5 mills (U. S. Bureau of Reclamation Estimate of Cost of Grand Coulee, 1932). These figures are based on a 50-year amortization program for the project and full use of 8,000 million kw.-hr. capacity within 15 years after its completion. Transmission and transformation costs will increase these figures from 30 to 50 per cent. For the present no power installation is contemplated at Grand Coulee.

Lower Columbia River Region: To the already extremely favorable power rates in this region, Bonneville injects a competitive factor, the significance of which is not yet apparent. Until Congress authorizes the War Department or some other government agency to dispose of Bonneville power and until such agency establishes rates and charges, industrial rate schedules are a matter of conjecture. Power rates will be dependent upon how much of the investment in the Bonneville project is charged to navigation and river improvement. If the original plans for alloting these charges are adhered to, a fair estimate of the power house switchboard cost of this power is less than 2 mills.

Organized efforts by local civic and commercial organizations are being directed toward the establishment of industrial rate schedules of a strictly promotional type for the purpose of developing a Pacific Coast industrial center around Bonneville as a nucleus. By some people such rates will be termed a direct subsidy to industry, but the successful culmination of such plans coupled with deep water transportation facilities would tend to minimize the factor of national distribution costs in plant location studies.

Northern California: In this region a surplus power rate negotiated on contract has been applied to two or three large chemical plants. This schedule carries a low step of 2.5 mills per kw.-hr. which permits the earning of attractive over-all average rates depending upon load factor and use. It carries a requirement that during the dry periods of abnormally dry years the serving utility may cut off service for a period of 3 months. Such a situation might arise once in 5 years. However, to date no companies receiving service on these contract schedules have had their power service shut off.

For extremely large loads, such as chemical process or metallurgical industries, special conditions and characteristics of the electrical requirements will conceivably influence the power rates and in such situations, final rates would be arrived at by direct negotiation between the customer and the serving utility. In general the statement might be made in regard to the northern California and San Francisco Bay industrial areas, that electrical energy will be made available at rates competitive with those of any other section of the Pacific Coast.

(Continued on page 478)

Fuel Resources to Meet Needs of Industry

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Part I—NATURAL GAS

By CLAUDE C. BROWN

Chief Engineer, California Railroad Commission, San Francisco, Calif.

NATURAL gas, as its name implies, is a natural product produced from wells, sometimes in conjunction with petroleum and sometimes free from oil. The former is commonly termed "casing-gas" and the latter "dry gas." All of the gas produced in California is utilized here, none being imported or exported.

In the year 1934 there was produced from the thirty-one actively producing oil and gas fields a total of 281,354,800 M.c.f., of which 264,634,800 M.c.f. were utilized and 16,720,000 M.c.f. blown to the air. Of the total annual production of 281,354,800 M.c.f., the following disposition was made:

	M.c.f.
Repressuring and storage	3,852,800
Gasoline plant fuel and shrinkage	47,586,300
Field fuel	38,510,200
Refinery and general use	7,041,200
Sales to utilities and others	167,644,300
Blown to the air	16,720,000
Total	281,354,800

That sold to public utilities (156,763,683 M.c.f.) and other industrial consumers (10,880,617 M.c.f.) is of most interest to prospective users among chemical industries.

The amount of gas blown to the air and wasted, amounting to 16,720,000 M.c.f., constitutes 5.94 per cent of the total gas produced. The reasons for this figure being as low as it is are, first, the careful administration of the gas conservation laws of this state and, second, the growing desire on the part of the producers to conserve the gas pressure in the deeper horizons for the purpose of lifting oil. There are no carbon black plants in California.

The principal gas transmission lines in the state are shown on the accompanying map. This map was made in 1932 but, since no important lines have been laid subsequent to that year, it accurately represents the present conditions.

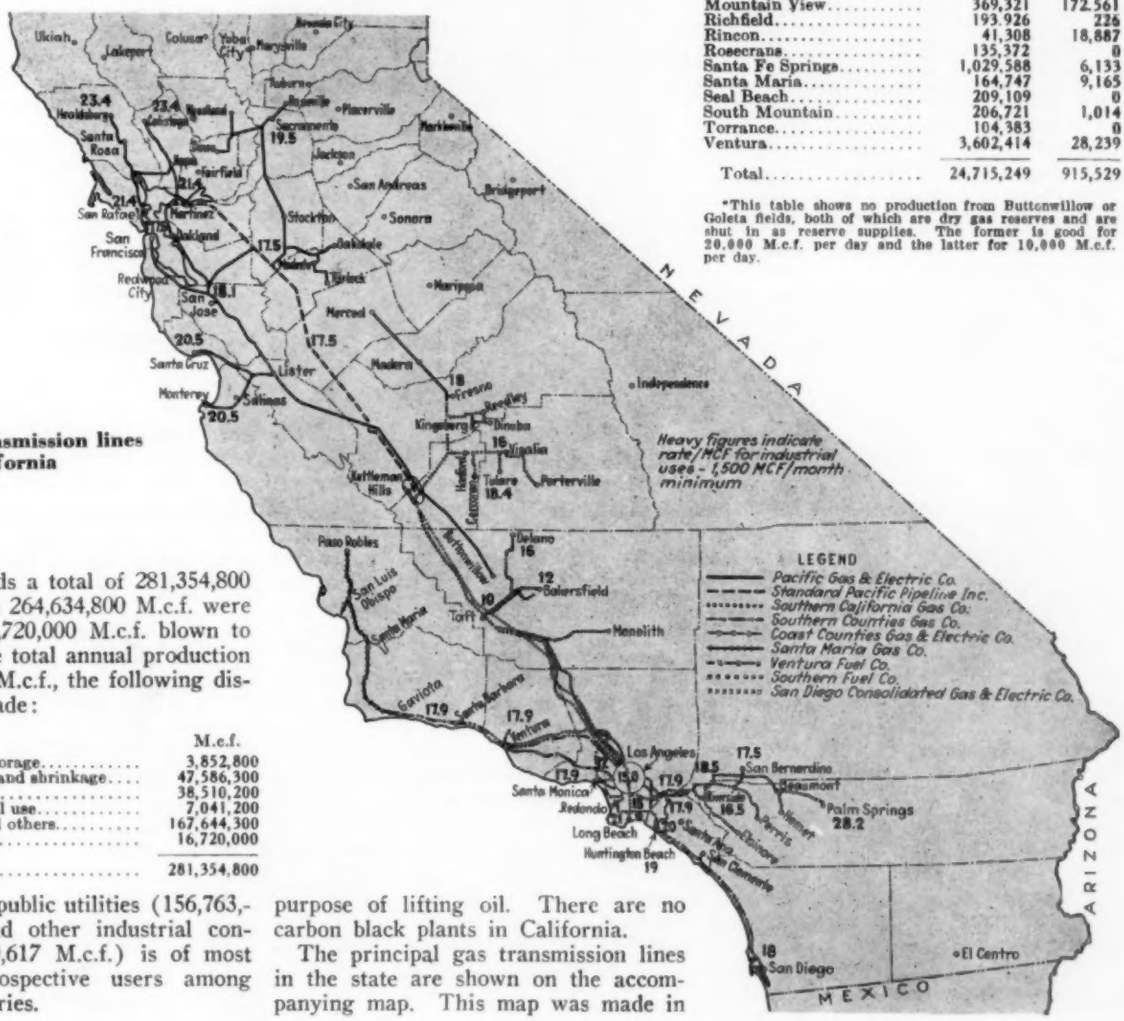
The heat content of the natural gas produced in California ranges from 960 B.t.u. per cubic foot of dry gas to 1,250 B.t.u. per cubic foot of casing-head gas, with the general average of 1,150 B.t.u. per cubic foot for all natural gas served.

The following table shows the production and wastage of gas, by fields, for the month of December, 1934, in M.c.f. Utilization is, of course, the difference.

Gas Producing Fields in California

Field*	Production	Wastage
Athens	9,914	13
Belridge	375,284	0
Brea	318,669	3,508
Cat Canyon	202	0
Coalinga	3,625	0
Coyote	299,053	0
Del Rey	164,125	855
Domingues	973,158	8,602
Elk Hills	64,203	0
Elwood	83,032	2,380
Fellows	82,281	0
Fillmore	28,217	77
Huntington Beach	1,939,610	438,548
Inglewood	112,269	0
Kettleman North Dome	10,965,778	212,080
Kettleman Middle Dome	445,643	0
Lawndale	10,700	0
Long Beach	1,566,765	908
Lost Hills	39,788	11,165
Midway Sunset	1,123,245	2,970
Montebello	52,799	198
Mountain View	369,321	172,561
Richfield	193,926	226
Rincon	41,308	18,887
Rosecrans	135,372	0
Santa Fe Springs	1,029,588	6,133
Santa Maria	164,747	9,165
Seal Beach	209,109	0
South Mountain	206,721	1,014
Torrance	104,383	0
Ventura	3,602,414	28,239
Total	24,715,249	915,529

*This table shows no production from Buttonwillow or Goleta fields, both of which are dry gas reserves and are shut in as reserve supplies. The former is good for 20,000 M.c.f. per day and the latter for 10,000 M.c.f. per day.



Natural gas transmission lines in California

Numerous estimates made by petroleum engineers, gas engineers and geologists all indicate that with the exercise of proper conservation all of the present producing fields will still be producing in the year 1950 and some of them longer. This period will undoubtedly be substantially lengthened by the future development of known and unknown producing areas. The present daily production is 730,000 M.c.f. per day and these estimates indicate that from the present fields alone there will be produced in 1950 approximately 500,000 M.c.f. per day.

The total number of new wells drilled in California during the year 1934 was 643. Of this total, 634 were drilled for oil and gas and nine for gas alone. Of the total of 643, there were completed during the year a total of 452 wells. This is compared with the annual completions of wells for the past ten years in California in the following table. Note particularly the effect of curtailment, which began in April, 1929.

Year	No. of Wells	Year	No. of Wells
1925	948	1930	755
1926	913	1931	246
1927	901	1932	184
1928	712	1933	243
1929	910	1934	452

Rates for Surplus Industrial Gas. There are seven public utility distributing companies that serve natural gas for surplus industrial use. They are: Pacific Gas and Electric Co., Coast Counties Gas & Electric Co., San Joaquin Light & Power Corp., Los Angeles Gas & Electric Corp., Southern Counties Gas Co., Southern California Gas Co., and San Diego Consolidated Gas & Electric Co.

Typical of the various rates under which surplus industrial gas is sold in northern California is the schedule shown in the accompanying table. These rates are applicable to consumers where operations can be readily continued with other fuels in case of shut-off of the gas supply. They also require 3-year contracts and are subject to increase with an increase in the price of fuel oil amounting to one cent per M.c.f. for each six cents per barrel of oil. Furthermore, service under these schedules is subject to discontinuance without notice in case of an actual or threatened shortage of natural gas, whether due to insufficient gas supply in the fields or to inadequate transmission or delivery facilities.

Typical of surplus industrial rates in southern California is the following schedule for the utility serving Los Angeles, San Bernardino, Riverside, Tulare, Fresno, Kern, and Kings counties:

They are applicable for the following uses: boiler fuel, building heating ($4,200 annual minimum), green houses, glass melting tanks, glass feeder furnaces, steel and iron melting furnaces, heat treating of steel and iron, vitreous enameling furnaces, core ovens, mold drying ovens, dehydrators and evaporators for fruit, nuts, hay, vegetables and milk, driers for sand, gravel, salt barrels, soap, magnesia, rugs, molasses, malt and metals, kilns and driers for brick, tile, pottery, porcelain, lime, cement, bone char, black ash and ore, swimming tanks, incinerators for garbage, asphalt melting tanks used in paving work, roofing and pipe manufacturing plants and for sulphur stills.

Kettleman Hills, source of most of the natural gas used in northern California. This field could supply the gasoline requirements of the entire Pacific Coast if necessary

Fairchild Aerial Surveys

Natural Gas Receipts by Utilities

Utility	M.c.f. Receipts
Pacific Gas & Electric Co.*	47,253,240
Modesto Gas Co.	599,685
City of Palo Alto**	254,592
Coast Counties Gas & Electric Co.	1,495,870
San Joaquin Light & Power Corp.	3,534,364
Santa Maria Gas Co.	1,082,454
West Side Natural Gas Co.	231,415
Commercial Land Co.	1,183
Southern California Gas Co.	42,413,018
Southern Counties Gas Co.	13,338,904
Los Angeles Gas & Electric Corp.	28,264,428
Southern California Edison Co.	10,612,969
San Diego Consolidated G & E Co.	4,642,347
City of Long Beach**	3,039,214
Total	156,763,683

*Includes Great Western Power Co.
**Municipally-owned utilities.

Typical Rates for Surplus Industrial Gas in Southern California

	Rates per M.c.f.			
	Base	Minimum	Maximum	Monthly Minimum
All gas	36¢	36¢	45¢	$35
All gas	26¢	26¢	40¢	75
All gas	21¢	21¢	36¢	150
All gas	20¢	20¢	35¢	175
All gas	18.5¢	18.5¢	34¢	190
All gas	18¢	18¢	33¢	200
All gas	17¢	17¢	32¢	300
All gas	16¢	16¢	31¢	325
All gas	15¢	15¢	30¢	350

Oil differential—plus one cent per M.c.f. for six cents per barrel of fuel oil at 85c.—El Segundo.

Carrying Capacities of the Principal Gas Lines

Line and Size	Location	M.c.f. per day
Pacific Gas & Electric Co., 20"-22"	Kettleman-San Francisco	75,000
Stanpac, 24"-26"	Kettleman-San Francisco	125,000
Southern California Gas, 10"	Kettleman-Fresno	17,000
Pacific Gas & Electric Co., 16"	Buttonwillow-Kettleman	50,000
Southern Fuel Co., 26"	Kettleman-Long Beach	130,000
Southern California Gas, 20"	Kettleman-Los Angeles	50,000
Southern California Gas, 12"	Ventura-Los Angeles	35,000
Southern Counties Gas, 12"	Ventura-Los Angeles	35,000
Ventura Fuel, 16"	Ventura-Los Angeles	55,000
Southern Counties Gas, 12"	Huntington Beach-San Diego	15,000

Typical Rates for Surplus Industrial Gas in No. California

Area	Rate per M.c.f. First 50 M.c.f. ¢	Next 50 M.c.f. ¢	Next 900 M.c.f. ¢	Next 2000 M.c.f. ¢	Over 3000 M.c.f. ¢
S. F. Bay Area	40	30	17	14	13
Peninsula & San Jose	40.7	30.7	17.7	14.7	13.7
Stockton	40	30	17	14	13
Sacramento	42	32	19	16	15
Vallejo-Benicia	41.7	31.7	18.7	15.7	14.7
North Bay Area	44	34	21	18	17
Healdsburg	46	36	23	20	19

Annual minimum charge—all $240 per year.

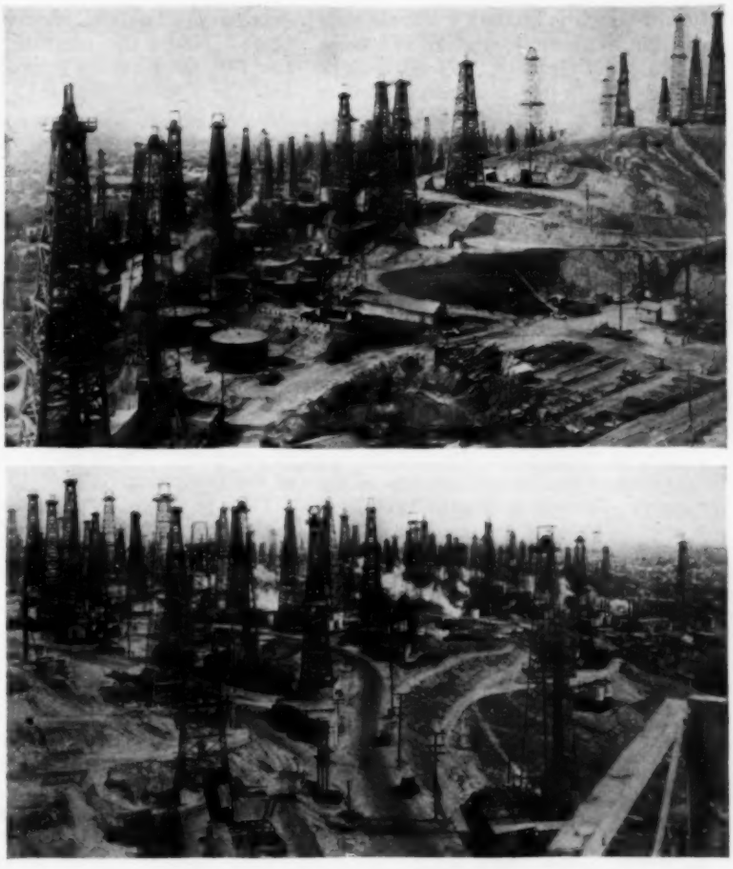
Receipts and Disbursements of Kettleman Natural Gas (North) in 1934

All figures in M.c.f.

Utility	P. G. & E.	Modesto	San Joaquin	Palo Alto	Coast Counties	Southern California (Valley)	Total
Receipts	47,632,917	599,685	2,339,476	254,592	1,495,870	1,014,730	53,337,270
Sales:							
Domestic and commercial	17,888,346	179,259	1,000,385	220,320	519,718	395,274	20,203,302
Gas engine	.....	.....	.....	.....	43,656	40,890	84,546
Firm industrial	649,549	.....	.....	.....	.....	.....	649,549
Surplus industrial	18,079,256	397,893	1,115,840	.....	779,577	431,212	20,803,778
Company Use:							
Gas plants	1,015,110	292	39,099	.....	1,516	1,209	1,057,226
Electric plants	5,941,007	.....	.....	.....	.....	.....	5,941,007
Losses	4,059,649	22,241	184,152	34,272	151,403	146,145	4,597,862

Part II—Petroleum

EDITORIAL STAFF SURVEY



Sections of the Los Angeles Basin fields where town lot drilling has developed a forest of derricks

PETROLEUM resources of the Pacific Coast, the development of which represents one of the territory's major industries, provide also one of its greatest industrial assets. Neither the first Indian who caulked his crude log boat nor the early Spanish explorer who was intrigued by the "pitch" which oozed from fissures along the southern California coastline ever envisioned the development of a billion dollar business whose black gold would bring greater riches to this region than all of the precious metal ever mined from its mountains and stream beds.

Around the petroleum industry as a nucleus, an expanding spiral of industrial development has grown, amplified on the one hand by the increasing requirements for steel, cement, chemicals and machinery and contributing on the other vast supplies of low-priced fuel oil and natural gas. Today this industry, largely concentrated in California, produces one-fifth of the nation's petroleum products. Some 500 companies operate 10,100 wells in twenty-seven producing fields, ranging from the lower San Joaquin Valley to the southern California shoreline. An additional 5,500 wells are shut in. Current production averages slightly more than 500,000 bbl. daily and potential production is estimated to be 1,433,470 bbl. daily. Peak production in August, 1929, was 890,000 bbl. daily.

Distribution facilities to bring this product to the 42 refineries with their daily capacity of 751,935 bbl. and to the shipping centers include 2,500 miles of pipelines, excluding those used for natural gas. Approximately 200,000,000 bbl. of storage capacity has been provided. Transportation facilities include tank cars, trucks and ships capable of carrying 10,000,000 bbl.

Although favorably known to the Indians and Spanish settlers, the petroleum resources were not exploited commercially until 1866 when an 80-ft. sloping tunnel was driven into one of the seepage fissures in Sulphur Mountain in Ventura County. The first accredited producing well was bored to a depth of 500 ft. at Newhall in the same county in 1875, and in 1876 the total production was 12,000 bbl. Since that year wells ranging in depth from 500 to 11,300 ft. have produced a total of 4,163,000,000 bbl. representing a value of some four billion dollars.

Some conception of the operations of the industry may be obtained from a study of the data in Table I which show comparative operations over a two-year period. The industry on the Pacific Coast has been more stable than in other sections of the country. Three years of voluntary curtailment preceded the federal control initiated in September, 1933. As a result there has been practically no over-production and refinery runs have been geared to market requirements. The recent imposition of import tariffs on oil from Mexico and South America has resulted in large shipments to the Atlantic seaboard with a consequent reduction in storage stocks of all grades.

Fuel Oil. The development of fuel oil markets was stimulated initially by overproduction during the early days of the industry. Intensive sales work resulted in the universal adoption of oil as a fuel by the Western railroads, by steamship lines and its substitution for coal and wood refuse in most industrial plants of the Pacific Northwest. Large quantities were also used for the generation of electric power and the manufacture of oil gas.

Subsequent discoveries of large quantities of natural gas materially changed this picture in so far as California is concerned. Gas has supplanted oil almost universally as an industrial fuel except in those cases where a plant is located beyond the gas pipelines. However, since many of the industrial gas contracts are on a surplus basis, the majority of the plants are equipped to change over to oil on short notice. In the Pacific Northwest, California fuel oil continues as one of the principal fuels.

Half of the present fuel oil production is used by railroads and for bunkering at the important seaports. This territory is strictly on an export basis at the present time. During six months of 1934 fuel oil shipments to the Atlantic seaboard were 10,101,330 bbl. Pacific foreign ports, principally Japan, drew 10,786,890 bbl. and Atlantic foreign ports 1,276,595 bbl. Favorable factors for the future include not only this increasing export market but also the rising demand for asphalt for road construction stimulated by PWA funds.

Price range on fuel and Diesel oil, the

latter of which is becoming increasingly important to industry, is given in a table. Currently the Grade C fuel oil may be purchased in the major industrial centers of the Pacific Coast at the following prices:

Los Angeles	$0.95	per bbl.
San Francisco	1.00	"
Portland	1.15	"
Seattle	1.15	"

Diesel fuel prices are quoted for the same territories as follows:

Los Angeles	$1.47	per bbl.
San Francisco	1.68	"
Portland	1.89	"
Seattle	1.89	"

Potential Resources. Much study has been given to the future reserves of the territory. Various estimates have been prepared to indicate that conservation is necessary. The one most generally accepted, places the ultimate reserves of the 149,000 acres of proved producing fields at 7,466,400,000 bbl., with 2,658,900,000 bbl. in the Los Angeles basin fields, 4,126,000,000 bbl. in the San Joaquin Valley fields, including Kettleman Hills, and the balance in the coastal fields. The estimates of possible future production from these resources vary between 3,500,000,000 and 4,500,000,000 bbl. At the current rate of draw-off, with no allowances for growth in consumption, these reserves will have a life of 18 to 24 years. However, much research is being directed toward methods for securing maximum production beyond that possible with today's system of pumping. These may extend the life of the fields materially.

Despite intensive prospecting, including new geophysical methods with the reflection seismograph, no important new discoveries have been made in California during the last two years. Some of the existing fields have been proved to possess reserves at greater depths and a few others have had their boundaries extended but no new areas have been brought into production.

Wildcat drilling has been extended into some sections of northern California with moderate prospects of developing additional supplies of natural gas, but to date no additional petroleum reserves have been uncovered.

Major oil producing fields in California, which it is estimated have a possible future production between 3,500,000,000 and 4,500,000,000 bbl.

Petroleum Statistics, in Bbl.

	1933
Crude production	173,083,319
Stocks in Storage (Dec. 31)	
Gasoline and engine distillate	11,538,000
Natural gasoline	2,204,000
Kerosene	1,443,000
Lubricating oils and greases	916,000
Gas oil and Diesel oil	4,156,000
Fuel oil residuum and heavy crude	89,731,000
All other commodities	45,453,000
Total	155,441,000
Net Supply Available to Market	
Gasoline and engine distillate	56,021,000
Natural gasoline	11,744,000
Kerosene	5,538,000
Lubricating oils and greases	1,597,000
Gas oil and Diesel oil	20,133,000
Fuel oil residuum and heavy crude	85,474,000
Total	180,507,000
Indicated Market Demand	
Gasoline and engine distillate	63,865,000
Natural gasoline	1,239,000
Kerosene	5,970,000
Lubricating oils and greases	2,063,000
Gas oil and Diesel oil	18,083,000
Fuel oil residuum and heavy crude	84,435,000
All other commodities	14,047,000
Total	189,702,000

Prices for 14-18 A.P.I. Gravity Fuel Oil and 27 Plus Diesel Oil

(Prices f.o.b. San Joaquin Valley refineries in tank car lots. Pipe line charges to San Francisco, $0.24 and to San Pedro, $0.20)

Year	Fuel Oil	Diesel Oil
1930	$0.5386	$0.8812
1931	0.4838	0.8172
1932	0.4923	0.8385
1933	0.4833	0.9642
1934	0.5915	1.0877
July 1, 1935	0.7500	1.2700

Part III—COAL

By OTTO HERRES

Assistant Manager, United States Fuel Co., Salt Lake City, Utah

COAL resources of Arizona, California, Idaho, Nevada and Oregon are comparatively limited. Washington and the Rocky Mountain states have large areas of coal lands. But the coal reserves of Colorado, Utah and Wyoming in particular, west of the Continental Divide, are tremendous. Coal mining is an important industry in Colorado, Montana, New Mexico, Utah, Washington and Wyoming and coal in varying tonnages finds its way from all of these states to the Pacific Coast.

The coal produced in the different states ranks from lignite to anthracite, but by far the largest quantity that moves to California, Idaho, Nevada and Oregon is high-grade bituminous coal. Because it is of good quality for both domestic and industrial use and large reserves are available, the bituminous coal is most important commercially for immediate consideration. Such factors as fuel values, handling qualities and transportation costs make this true and overcome any price advantages possessed at the mines by lower rank coals.

The state of Washington is amply supplied with coal and particularly fortunate in the proximity of its fields to Seattle. It can provide for its own needs for many years to come, with the exception of some domestic coal in the larger sizes and industrial coal for special purposes east of the Cascades. Subbituminous coal is mined near Bellingham, bituminous coal in the central

area, near Seattle, sub-bituminous coal in the south not far from Portland, Ore., and bituminous coal east of the Cascades, in the Roslyn-Cle Elum field. Anthracite occurs in the mountains near Glacier and elsewhere but is not mined in commercial quantities.

Output from the beginning of mining in Washington to the end of 1934 exceeds 119,000,000 tons. The record production was 4,082,212 tons in 1918. Reserves are estimated to exceed 60,000,000,000 tons, much of which is, however, of no commercial value at present prices. Many of the coal beds are thin and contain impurities, causing higher mining costs and preparation charges to clean the coal by washing or other means than for bituminous coals of competing states, and no great percentage of lump coal is produced.

Arizona, California, Idaho, Nevada and Oregon combined produce less than 50,000 tons of coal a year. Records show that California, Idaho, Nevada and Oregon have taken most of their requirements from Utah and southern Wyoming. From present indications, this will continue to be the case, with the exception of the tonnage moving from Washington to Oregon. Utah has supplied the largest proportion of the tonnage. Southern Wyoming coal goes to a large extent to the railroads and finds a considerable commercial market to the east and north. Since Utah is and has been the main source of coal supply for California, Idaho and Nevada and to some extent Oregon, the coal resources of Utah might well be considered briefly, as well as certain economic aspects of the coal industry.

Government estimates show enormous deposits of high-grade bituminous coal in Utah. There are 350,000,000 tons of coal available for mining within 40 years and 46,000,000,000 tons of reserves of present value for mining after 40 years, according to the Engineers' Valuation Committee of the United States Coal Commission. The thickness of the coal beds is remarkable. About 75 per cent of the output is recovered from beds ranging from 8 ft. to 17 ft. thick, as compared to about 12 per cent of the output of the entire country from such beds. About one-third comes from seams at least 16 ft. thick, compared to 0.5 per cent of the total output of the country from beds of that thickness.

The coals are notable for their low content of impurities and their excellent physical character. They contain as a rule less than 7 per cent of ash and 0.5 per cent to 0.7 per cent of sulphur. A representative analysis of coal delivered for government use is as follows:

	As Received	Moisture Free
Moisture	4.65%	
Volatile Matter		45.53%
Fixed Carbon		48.21%
Ash		6.62%
Sulphur		0.64%
Heating Value	13,010 B.t.u.	13,650 B.t.u.

The importance of this to consuming states is that extensive deposits of high-grade bituminous coal, in thick, clean beds, under conditions favorable to mining, mean low cost fuels. California for years has been producing about one-fifth or more of the crude oil of the United States. When increasing consumption overtakes and passes production, as it inevitably will from one cause or another, it will be necessary then to turn to coal. With its large population and growing industries, California uses now less than $\frac{1}{10}$ of 1 per cent of the nation's coal.

Prices on Utah coal to trade areas on the Pacific Coast in sizes used for industrial purposes are this year to date as follows, per ton of 2,000 lb., f.o.b. mines:

Stove (3"x8")	$3.40
Egg (1¼"x6")	3.00
Nut (1¼"x3")	2.75
Stoker (¾"x1")	1.75
Slack (Through 1¼" openings)	1.50
Slack (Through 1" openings)	1.25
Straight Mine Run	2.70
8-in. Mine Run	2.30
3-in. Mine Run	2.00

By far the largest tonnage of coal used for industrial purposes is 1-in. slack at the price of $1.25 per ton.

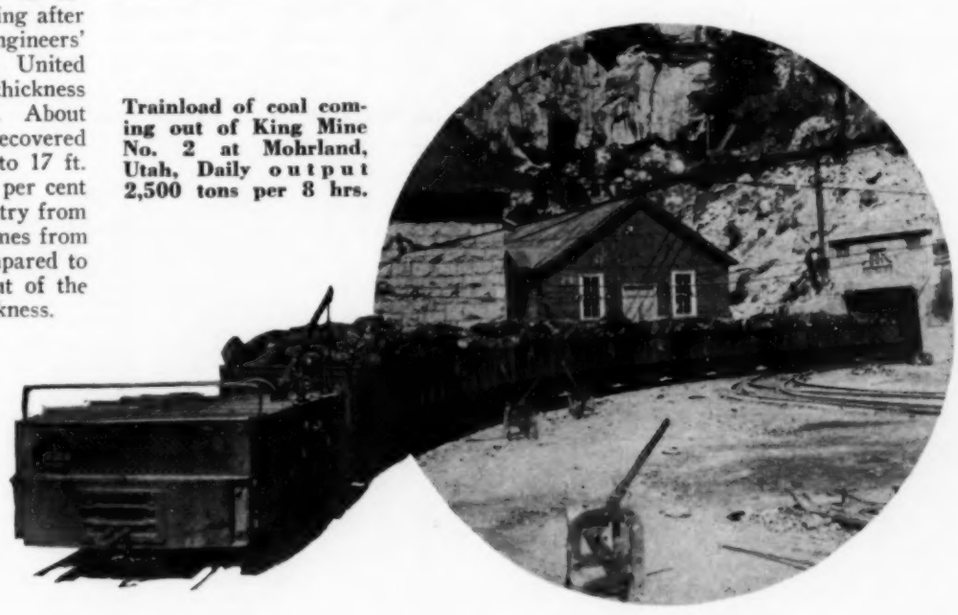
These prices are representative for existing conditions in the Utah coal industry. Mining is conducted under a labor agreement with the United Mine Workers of America, arising from Section 7 (a) of the former National Industrial Recovery Act, involving a 7-hour day, 35-hour week and basic wage for unclassified labor of $4.48 for 7 hours outside the mines and $5.28 for 7 hours underground ($5.44 minimum for skilled labor, underground, 7 hours).

Freight rates on Utah coal to representative points on the Coast are:

	Seattle	Portland	San Francisco	Los Angeles
Lump	$6.35	$5.90	$6.00	$6.00
Nut	....	5.40	....	....
Slack	6.35	5.15	5.15	5.15
Bunker & Trans-shipment				
Short Ton	4.75	4.75	....	....
Long Ton	....	....	4.75	4.75

The tonnages on which these mine prices and freight rates are based are comparatively small as coal mining goes. Coal mining for industrial use is essentially a large volume, low cost operation, and the same is true of coal transportation by railroads. It is reasonable to assume that when the demand for coal on the Pacific Coast reaches proportions comparable to Eastern industrial centers, coal in the tonnages required will be available at prices as low as prevail in the large coal fields supplying the Atlantic seaboard and at correspondingly low freight rates for the distances involved. In the meanwhile, Utah, in order to maintain a semblance of volume, is forced to spread out distribution in thin tonnages over a wide area, actually reaching in some degree from the north boundary of Mexico to Nome, Alaska, and from the Pacific Ocean eastward to Nebraska.

It is said that no section of the country can become a great industrial center without coal and iron. Utah and the Rocky Mountain states have abundant resources of coal available—to say nothing of iron—for the growing empire of the Pacific Coast.



Trainload of coal coming out of King Mine No. 2 at Mohrland, Utah. Daily output 2,500 tons per 8 hrs.

ADEQUATE WATER SUPPLIES ASSURE INDUSTRIAL DEVELOPMENT

By PAUL F. BOVARD
Consulting Chemical Engineer, San Francisco, Calif.

O'Shaughnessy Dam of San Francisco's Hetch Hetchy water supply system

WATER supplies of satisfactory quality for various manufacturing purposes at a low cost has been a subject of major importance on the Coast. This discussion will be confined to surface supplies of Washington, Oregon and California, including the underground sources in California. A wide variety of climatic conditions exists within this comparatively small area. One cannot speculate on the future or existing available water supplies in industrial quantities without referring to rainfall data illustrated in the accompanying diagram. The isohyetal curves illustrate the significant fact that the coast states have definite limitations as far as surface water is concerned.

From the industrial standpoint, the surface water supplies usually offer independent sources from the local domestic system. Cheap power and abundance of water of good quality are usually associated with high annual precipitation. From this standpoint, the Pacific Northwest, including western Oregon and Washington, obviously offers facilities of this sort. A perpetual snow cap in the Cascade Mountains assures a rise of continual high-capacity flow in streams and tributaries, particularly in the state of Washington. Traveling southward in Oregon and in California, the differential increases between the low and high mean discharge capacity. In recent years there have been examples in the Pacific Northwest of higher temperatures and lower precipitation averages which have been seriously felt in the industries depending upon large quantities of water. Table I indicates the general characteristics of the principal rivers in Washington, Oregon and California. The range of total dissolved solids is included to illustrate the fact that in most of the water supplies it is necessary to take into account these variations in the method of treatment employed during the seasonal cycles.

The statistics correlated with the isohyetal curves suggests that rainfall and precipitation data become more significant in California than in Oregon

Table I—Data on Water of Major Pacific Coast Rivers

Principal Rivers	Principal City	Mean Discharge (Sec.-Ft.) Low	Mean Discharge (Sec.-Ft.) High	Range Total Dissolved Solids (p.p.m.)	Mean Average (Ca) + (Mg) (p.p.m)
Washington:					
Cedar	Seattle	170	1,600	30–80	8
Chehalis	Centralia	1,500	7,000	40–120	9
Columbia		60,000	600,000	70–130	21
Green	Tacoma			30–109	7
Klickitat	Klickitat	900	6,000	55–105	11
Okanogan	Okanogan	tributary		65–180	26
Skagit	Mt. Vernon	6,900	29,000	32–80	9
Snake	Lewiston	14,000	200,000	80–180	20
Spokane	Spokane	1,900	25,000	50–90	15
Venatchee	Wenatchee	1,000	15,000	30–100	8
Wynootche	Aberdeen	100	10,000	40–60	11
Yakima	Yakima	300	17,000	70–280	22
See W.S. Paper—339, pp.97 and 94.					
Oregon:					
Columbia	(See Washington data)				
Snake	(See Washington data)				
Rogue	Grants Pass	1,100	14,000	60–80	9
Umpqua	Roseburg	1,000	22,000	60–80	11
Grande Ronde	La Grande	100	6,000	80–110	12
Deschutes	Bend	1,000	11,000	60–120	11
Bull Run	Portland	100	4,000	20–40	4
McKenzie	Eugene	2,000	15,000	40–55	6
Santiam	Albany	800	8,000	30–70	7
Clackamas	Oregon City	800	4,000	40–80	6
Willamette	Portland	6,000	120,000	56–90	10

Principal Rivers	Principal City	Mean Discharge (Sec.-Ft.) Low	Mean Discharge (Sec.-Ft.) High	Range Total Dissolved Solids (p.p.m.)	Mean Average (Ca) + (Mg) (p.p.m.)
See W.S. Paper—363, p. 125					
California:					
American River	Sacramento	300	70,000	110	17
Klamath	Klamath Falls	2,000	4,000	180	24
Mad	Eureka	20	40	185	34
Sacramento	Sacramento	4,000	180,000	149	24
San Joaquin	Stockton	400	15,000	220	46
Cache Creek		2	1,400		
Mokelumne	Oakland	100	6,000	62	11
Yuba N. Fork	Downeville	40	2,200	72	18
Eel	Scotia	50	200	180	35
Feather	Oroville	1,200	35,000	40	6
Russian	Guerneville	3	300		
Tuolumne	Groveland	70	50,000	17	3
Trinity	Helena	150	2,300	45	7
Kern	Bakersfield	4	3,000		
Kings River	Sanger	300	12,000	40	8
Stanislaus	Oakdale	300	8,000	20	4
Merced	Merced	100	37,000	40	7
Carmel	Monterey	0	3	304	53
Salinas	Kings City	0	10		
Los Angeles	Los Angeles	1.6	22	378	87
Santa Ana	Riverside	0	1,800	300	40
San Gabriel	Pasadena	0	9,000	208	57
Colorado	Los Angeles	4,000	80,000	2,800	232
San Diego	San Diego	0	700	220	60

and in Washington. The storage of water during peak discharges has been found necessary for industrial and domestic supplies as well as irrigation and power. However, the recent cycles of low average precipitation coupled with population growth in the states of Oregon and Washington have made necessary also the provision of large impounding reservoirs to safeguard domestic and industrial supplies. Unusual low water has been recorded in many rivers in the Northwest within the last four years in spite of the fact that flood proportions have been encountered in certain tributaries. General distribution of precipitation has not been advantageous in recent years.

Industries in the Northwest such as the pulp and paper mills have confined their activities to locations affording abundant raw material as well as quantity of satisfactory water. In California, the choice of location solely for abundance of good quality water cannot be considered. Here the mountain streams tributary to the principal rivers, the Sacramento and the San Joaquin, are subjected to seasonal flares of runoff. Toward the southern part of the state, the rainfall and precipitation diminishes and flares are sudden and of short duration. At the present time the principal development looking toward the establishment and security of adequate industrial and domestic water are confined to sources beyond the boundaries of the state.

While the cost of water for industrial purposes may not be of primary importance it is one of the factors entering into the selection of industrial centers. Many industries do not require large volumes of water, but are more concerned with the quality and are satisfied to depend on the domestic supply available. There may be other factors such as transportation, power, fuel and markets which offset the consumer rates for industrial purposes. The financial set-up of the water distributing system and the program for expansion and construction have much to do with the customer charges.

In the northern section of the Pacific Coast where the water rates are low, obviously the supply is abundant, and industries do not depend on the domestic system for their water requirements. In California the high cost of employing domestic water for industrial purposes has led manufacturers to avail themselves of the data acquired from underground explorations. Irrigation engineers have been the most active in the application of these data. The unreliability of the surface supplies for industries requiring from 50,000 to 1,000,000 gal. daily has justified large financial outlays for the development of these underground water supplies.

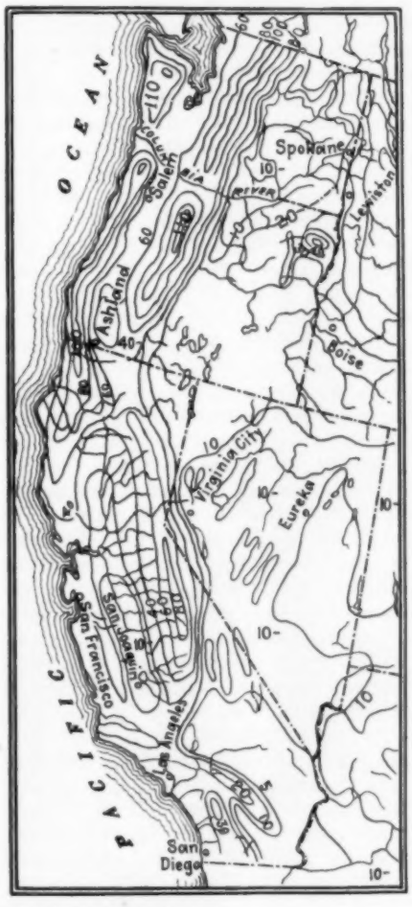
The quality of the surface water in California is variable with the seasonal cycles, and usually necessitates changes in methods of treatment during high and low water. It is unfortunate that underground stratigraphy is not more fully understood. So far data on subsurface water have not led to any certainty in the prediction of the quality or quantity of water available in the underground reservoirs. The influence of recent volcanic activity together with constant marine contacts is indicated in the quality of water produced in the majority of well supplies. Most industries using well supplies pumping at a rate of from 500 to 1,000 gal. per min. or more require either softening or filtration or both in addition to the cost of drilling wells from 150 to 1,500 ft. in depth. In many sections of California the water tables are constantly lowering and involving additional cost of pumpage with curtailment of capacity oftentimes forced by legal injunction. In the San Francisco Bay region care is required in a satisfactory pumping zone to prevent saline encroachment at the diffusion zone. Where the immediate effect of high pumpage in any one locality results in the lowering of the water table in the adjacent wells, indication of the limitation of the underground reservoir is evident. For these reasons cost for water in industrial proportions has involved expenditure of large sums of money by many industrial enterprises.

Table II—Customer Rates for Industrial Water

City	State	Cost for 1,000 Gal.
San Francisco	Calif.	25.9
Oakland	Calif.	21.3
Calif. Water Service*	.....	23.4
Los Angeles	Calif.	7.0–9.0
San Diego	Calif.	26.7
Portland	Ore.	5.0
Seattle	Wash.	4.0
Tacoma	Wash.	2.0

*Serving industries in San Francisco Bay region from river pumpage.

Statistics correlated with isohyetal curves suggest that rainfall and precipitation data become more significant in California than in Oregon and in Washington



Underground supplies in the Los Angeles section have geological advantages that assist in maintaining stability in water table elevation. For this same reason the quality of underground water has less variation. All of the wells, however, in the state of California are classed as hard water and contain calcium and magnesium salts in excess of 5 grains per gallon. Many of the industrial plants use wells containing 4 to 5 times this concentration.

Outside of the fact that there is a wide variation of the quantity of water in different sections of the Pacific Coast, the problem of water quality is not very different from that in any other part of the United States. The fact that larger water storage is required in the development of water supplies guarantees a certain amount of security to the industrial consumer. Stored water, however, is effected by the phenomena of low humidity and seasonal flares of microorganisms. The evaporation losses in the southern regions have been known to equal the actual draft on the system. Therefore, the concentration of dissolved solids and organic matter has often caused complete revisions in the control of purification works. However, these problems are not unusual in other industrial centers in the United States. There will be encountered, however, the unique feature in California that the climatic characteristics, as so far recorded, indicate at least 6 months without any rain or precipitation in central valleys or west coast.

In inviting prospective industries to the Pacific Coast, it will be necessary to take into account the actual data of water supplies as a vital consideration. Data so far recorded on surface and underground water either by exploration or by direct usage give a measure of assurance to future industrial development. Engineering studies are keeping pace with the requirements and construction programs are primarily centered on water development for future security.

Section of San Francisco's waterfront and harbor showing construction of San Francisco-Oakland Bridge

PACIFIC COAST TRANSPORTATION FAVORS PLANT LOCATION

By HAL M. REMINGTON and **RALPH B. KOEBER**
General Secretary, Pacific Coast Transportation Advisory Board — *Industrial Engineer, San Francisco, Calif.*

CITIES of California, Oregon, and Washington, located on the deep waters of the Pacific or on the many navigable tributaries have for many years presented to shippers and receivers of freight adaptable and most favorable transportation conditions. From a transportation standpoint, the areas served by these cities are essentially interested in the marketing in an easterly direction of the products of field, forest, mine, and orchard, and in the receipt and redistribution of manufactured articles, together with such processed commodities as may be produced in contiguous territory.

As the tonnage movement is preponderantly to the east, an adequate supply of freight equipment is always assured for moving westbound shipments over the routes afforded by the seven transcontinental railroads serving this part of the country. In addition, a frequent and dependable water carrier service is maintained by 22 intercoastal steamship lines operating through the Panama Canal, 27 Pacific coastwise lines, and various lines serving landings on the Sacramento, San Joaquin, Columbia, and Willamette rivers, as well as on Puget Sound. There is also ample highway, air, and off-shore ocean service, the latter operating to and from all foreign world ports.

Each of the foregoing agencies is available for the movement of processed articles and raw materials produced in the Pacific coastal area at rates that are maintained at reasonable and non-discriminatory levels due to the existing competition between rail, water, and highway carriers. It should here be indicated that with a few minor exceptions, railroad rates between Pacific Coast cities and points in the United States east of the Rocky Mountains are on a parity; that is, the rate on a given article between Chicago and San Francisco, for instance, will be exactly the same as that between Chicago and any other Pacific Coast city. This is due to the fact that rail distances between the communities mentioned are practically the same in all instances. The result of the situation just described is that intercoastal carriers operating between the Atlantic and Pacific seaboards likewise provide identical rates between all Atlantic and Pacific Coast cities, and this despite the fact that the distance by water from Los Angeles to Seattle is 1,320 miles.

In the distribution of products from the Pacific Coast to other regional markets throughout the nation it may be said that as a general rule rail freight rates from the Pacific Coast on commodities produced in this region meet westbound rail rates on commodities produced on the Atlantic Coast just east of the Colorado line; in competition with Chicago and Mississippi Valley points the line follows the Rocky Mountains. Where semi-manufactured products produced on the Atlantic Coast are shipped by intercoastal water carriers to the Pacific Coast for further processing or assembling, the finished product may be moved by rail eastward to Salt Lake City, the approximate breaking point compared with westbound shipments of the same product.

For many commodities the advent of the Panama Canal intercoastal water freight rates brought the Pacific Coast as close to the Atlantic seaboard, commercially, as Chicago and Mississippi points. Gulf seaboard points are served as economically from the Pacific Coast by water as many inland points in California, Oregon, and Washington by rail or truck.

In the distribution of products to the non-contiguous territory of Hawaii the freight rates by water make the Hawaiian Islands figuratively only 70 miles from the Pacific Coast in terms of rail or trucking freight costs. The freight rates by water between the Pacific ports and a number of foreign ports in the Pacific littoral and in Central and South America bring these markets and the available raw material supplies as close to the Pacific Coast as the adjacent western states by rail or trucking costs.

A study of the freight cargo movement by water from the Pacific Coast shows that in recent years the outbound coastwise and intercoastal cargo tonnage from the Pacific Coast ports amounts to approximately 25 per cent of the outbound coastwise and intercoastal tonnage in the United States. The inbound cargo tonnage accounts for 26 per cent of the United States total.

THE Hawaiian Islands market received more than 783,000 tons of goods during one of the recent years from the mainland. Of this more than 93 per cent cleared from Pacific ports. Shipments from the Hawaiian Islands to the mainland amounted to more than 1 million tons; of this amount 65 per cent came to Pacific ports.

Export cargo tonnage to foreign countries and non-contiguous territories through Pacific ports amounts to 25 per cent of the United States total. The

Los Angeles 2,526,99

net tonnage of vessels which entered and cleared in foreign trade from the Pacific Coast amounts to 27 per cent of the total for all United States sea ports.

In addition to the markets outside of the Pacific Coast states there is the market within the three Pacific Coast states, which, expressed in relation to the total market within the United States, and appraised by a few of the prominent factors, is revealing. Our study shows these three states with 6.7 per cent of the total United States population accounted for 9.4 per cent of the retail sales; 9.3 per cent of the wholesale sales; produced 6.1 per cent of the total value of manufactures; 13.2 per cent of the gross agricultural income; 13.2 per cent of the mineral production by value, and 44.8 per cent of the lumber production by quantity.

The distribution of the population and resources within the Pacific Coast states is not uniform throughout. Some sections are widely known for their production of lumber, fishery, and milled products; others dominate in the production of canned and preserved fruits and vegetables, paints and varnishes, and vegetable oils; while other sections predominate in the production of petroleum and motion pictures.

There are four major ports or trading centers on the Pacific Coast—Seattle, Portland, San Francisco, and Los Angeles. Some offer greater possibilities and opportunities for specific industries than others. The choice should be determined by the sum total of all the economic advantages available, including distribution of market, transportation, and production costs.

The market areas contiguous to these four trading centers have been greatly influenced by the preferential freight zones established by freight-rate common points between these various centers. The decisions of the Interstate Commerce Commission would indicate a disposition to fix the rates at a point where a normal and healthy struggle between competing interests have tended to leave them with consideration towards the cost of the services.

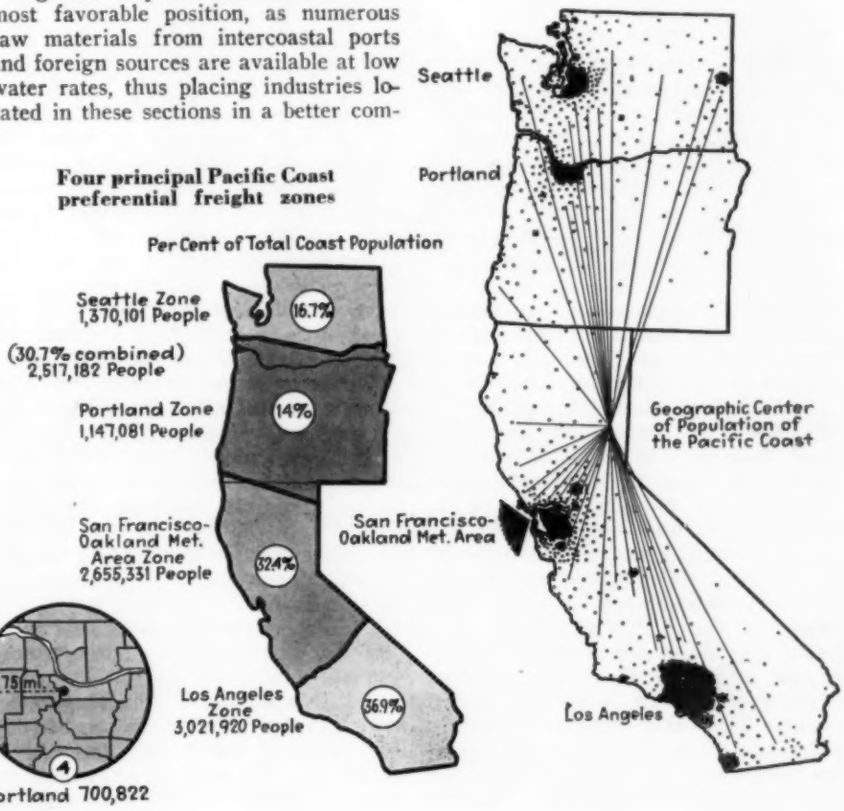
The market is perhaps the single factor most frequently influencing the choice of an industrial location. Market areas for different products are constantly changing. The rise of industries on the Pacific Coast was in response to an increasing market. It is true that many industries are local in character. There are industries of bulky products of small value which are confined to the local area because of heavy transportation costs. Valuable articles of small size may be produced independent of proximity to immediate market.

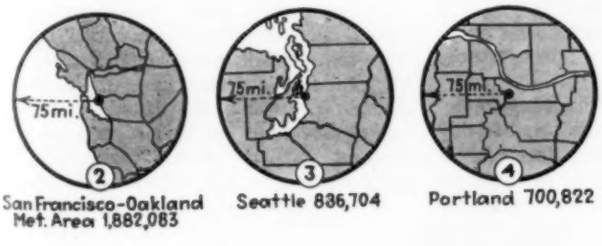
Cost of distribution, more than any other factor, limits the market area. It has been estimated that about 55 per cent of the raw materials used in industries come from agricultural operations. It is very natural that these materials should be used by industries near the source of their production, otherwise extra transportation costs for waste products may result. The general tendency is to perform the primary operations in the vicinity of the raw material supply in such industries as lumbering, petroleum production, mining, fishing, paper mills, and raw dairy products.

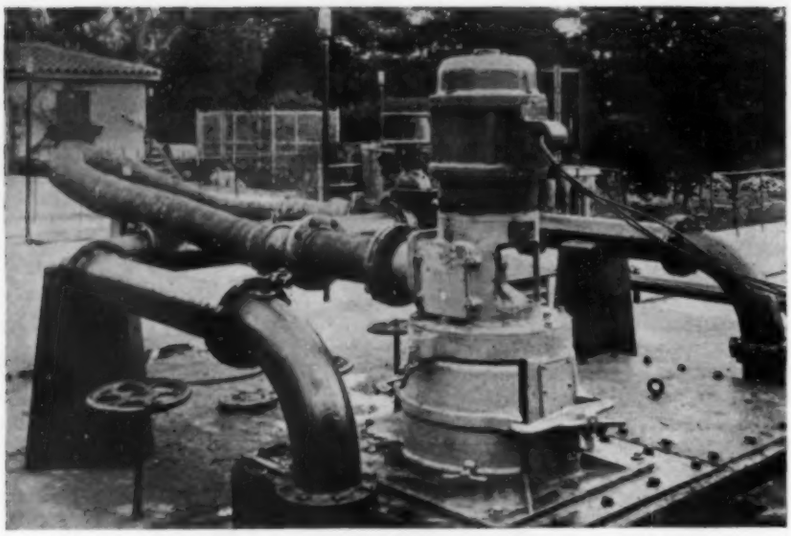
MANUFACTURING operations following the primary operations which involve application of skilled labor or special machinery and are integrated with other industries can be more removed from the source of raw materials and closer to the market centers. Cities supply large reserves of all classes of labor to draw from and therefore attract many industries on that account. Cities also contiguous to port facilities are in a most favorable position, as numerous raw materials from intercoastal ports and foreign sources are available at low water rates, thus placing industries located in these sections in a better competitive position in respect to world markets.

Although it is well known that the market factor and freight rates to the markets are among the leading factors governing industrial plant locations there are other important considerations such as raw materials, power, water, and fuel costs, labor supply and living conditions, legislation, taxation, and financial facilities. Therefore, no one section of the Pacific Coast has in the past attracted all of the industrial development, nor is this likely to happen in the future. Unquestionably this development will be shared by all the Pacific Coast primary market areas because the economic market minimum will justify establishment of a production unit to serve the local market or because the local conditions and production factors peculiar to a particular industry obtained in one of these market areas.

However, it is a significant fact that when a chemical industry or any other industry attempts to determine a location for its plant on the Pacific Coast, based on a scientific dollars and cents analysis, the site for the manufacturing plant will be found where the algebraic sum of the distribution and production cost factors will be the lowest. Only a most thorough analysis of the freight rate structure and the production factors intimate to the particular industry involved should dictate the final choice of a location.







Sewage disintegrator: An experimental installation in Golden Gate Park at San Francisco of a mill for reducing sludge and screenings to slurry

WASTE DISPOSAL

On the Pacific Coast

By N. A. BOWERS

Pacific Coast Editor,
Engineering News-Record
San Francisco, Calif.

MANAGERS of industrial plants who give thoughtful study to waste disposal problems on the West coast have available well-organized, co-operative aid as well as the advantage of sufficient land for such pretreatment as sedimentation, evaporation and other pondage or space-requiring methods. Secretive practices are being abandoned; the policy of today is to accept the theory that waste disposal involves (1) risk and (2) opportunity. On the one hand methods that cause nuisance are certain to react and eventually may be stopped by legal action; for such wastes control and treatment at the plant is the only safe course. On the other hand there may be value in some by-product of waste; at least there is every advantage in thorough study of its characteristics and discussion with the various control agencies as to methods of treatment. The number and variety of waste disposal problems that have arisen on the Pacific Coast in recent years have developed a valuable background of experience in their solution.

In most western states the use of streams and other natural waterways for waste disposal is under the watchful supervision of state officials who impose certain limitations. Because greater stream flow means greater dilution, industrial waste problems vary with rainfall of the region. In the Northwest where precipitation is heavy and streams are relatively large, the problem of securing dilution is simpler than in the Southwest where water supply is limited and sewage and stream flows are more concentrated. On the basis of quantity of stream flow the coast naturally is divided into two regions; the line of separation generally speaking is in northern California. To the south, rainfall is relatively light.

The large extent to which industrial wastes find their way into natural water channels makes the usual waste disposal problem very largely a question of what effect the waste will have on the particular waterway involved and hence what will be the resulting requirements on the industry. Four general classifications of possible nuisance are to be considered. California probably affords the most general example because in that state regulation in all four classes is under commission control.

(1) Because of the high "playground value" of rivers and ocean beaches any waste disposal that would affect recreational uses of waterways and shores must be controlled. (2) Preserving the purity of potable waters (as well as recreational uses) is under the Department of Public Health; (3) safeguarding fish life is under the jurisdiction of a state fish and game commission in each of the Pacific Coast states and (4) in California control of disposal of wastes from mining and ore reduction processes is the sole function of the California Debris Commission. Each of these three commissions has its limitations: the Board of Health has no jurisdiction unless health menace or nuisance is involved; the Department of Fish and Game is concerned with only those wastes that can be shown to be harmful to fish life and the Debris Commission deals only with "navigable waters." Moreover, each of these organizations is willing to render a co-operative service to industries and ofttimes can make valuable suggestions.

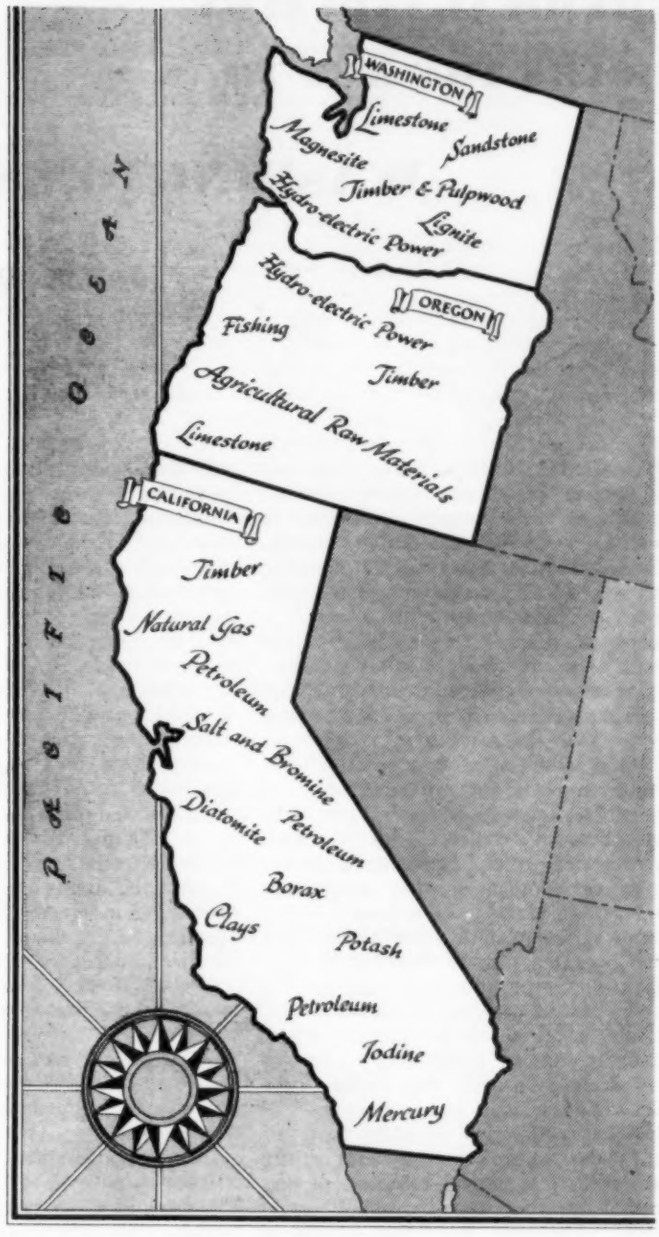
Sewers have come to be more and more the accepted channels for the disposal of western industrial wastes. Because of limitations that must be placed on dumping certain classes of wastes into sewers, there has been much experiment in the development of pretreatment and in finding suitable reduction, neutralization or dilution methods. Moreover, the widespread interest in attracting new industries gives an incentive to co-operative effort so that the prevalent attitude is to aid and encourage industries. Public sewers are used extensively although there are a few examples of private sewers (a notable instance of which will be cited). Where sewage treatment plants are maintained, the functioning of the treatment, whether chemical or bacterial, must be protected and, of course, there always is a taboo on acids or other chemicals strong enough to damage sewer pipes.

Los Angeles is unique in that, despite the dry climate, it has a sewage flow large enough to afford great dilution. One of its trunk sewers carries an average flow of 200 sec.-ft. This represents collection from a large area; the sewer length to some of the more distant points is 45 miles. It is in the upper reaches of such a system and not where the volume of flow is large that waste disposal problems are most serious.

Many forms of waste previously dumped on unused land now are being reduced to a fineness such that they can be pumped into sewers. This change is coming about more from an economy motive than because of municipal restrictions, although the latter have appeared in some quarters. Cannery wastes constitute an example; even where no nuisance is created by dumping spoiled fruit on land owned by the packing company, it still is cheaper in some instances to reduce the waste

(Continued on page 472)

3 Statesfull of Resources and Opportunities



WASHINGTON, Oregon and California have their stories to tell in terms that appeal particularly to the chemical engineer who is looking to the future of the process industries. Resources overflow state boundaries and opportunities are not limited by political geography. Yet the states are handy units from which to view the following exposition and inventory of raw materials and industrial prospects on the Pacific Coast.

CHEMICAL INDUSTRY HOLDS THE KEY TO WASHINGTON'S RESOURCES

By H. K. BENSON
Professor of Chemical Engineering
University of Washington
Seattle, Wash.

IN RESPONSE to the urge to use natural resources, chemical industries have been already established to some extent in the state of Washington. It was here that a pioneer arc plant for nitrogen fixation operated with success, both technical and financial, over a decade of years. Two electrochemical plants for the production of chlorine and caustic soda have recently enlarged their capacities. The production of pulp from wood has reached to as much as 1,500 tons a day. A portion of this pulp is prepared for non-paper uses and the whole industry is under most careful chemical control with research laboratories in the background to aid in the development of superior qualities and new products. To a lesser extent, chemical and metallurgical plants have been operated for the disposal of ores, clays, and other minerals and for the production of cement and building materials. Likewise, the production of milk products and of insecticides by the dairy and fruit industries has required the services of chemists and engineers. The chemical industry of the state, however, is in the nature of a general utility rather than a natural resultant of scientific progress and industrial enterprise. The fact that large blocks of electricity are obtainable at low rates is the basis of the existing chemical industry in the state.

The introduction of new chemical industries into this region will be due to favorable conditions for plant location and cheaper raw materials than elsewhere. Some years ago the writer was asked to prepare an article showing how the pulp manufacturers of the Pacific Coast could send their product across the continent in competition with the pulp mills of the East. Several striking facts were at once uncovered in the investigation, such as the much lower costs of pulpwood and steam than prevailed elsewhere. The Panama Canal freight rates, too, were not greater than the rail rates from many pulp mills to their converting mills.

It is unwise to erect barriers along state boundaries within which chemical industries may be confined. They do not thrive in isolation or aloofness, but they are dependent upon correlation with each other. They flock together and mutually feed upon each other, consuming not only raw materials, but also each other's products.

For example, in one of our smelters at the present time more than 100 tons of sulphuric acid per day are wasted from the high stack that carries the sulphur dioxide into a region where it does no harm. If recovered in a single sulphuric acid plant the enterprise would prove a failure, for there would be no market for this surplus product. Plainly it must be used as a step in some processing industry. This step may be found in an organized, fully integrated, fertilizer industry. Such an industry will contain the following units or elements in its comprehensive system of processes: (1) the fixation of nitrogen from air, water, and either coke or electricity; (2) the manufacture of phosphoric acid from phosphate rock, sand, and electricity; (3) the production of sulphuric acid from native pyrites, waste sulphur dioxide or Texas sulphur; (4) the production of nitric acid from the burning of synthetic ammonia; (5) the making of various fertilizer salts, such as ammonium phosphate, ammonium sulphate, and ammonium nitrate; (6) the processing of potash salts from Carlsbad, N. M., and combining them with other fertilizer salts; (7) the development of salvaged organic matter from fisheries, meat packing, garbage waste, and peat deposits; (8) the production of crystalline urea from ammonia and carbon dioxide.

TO OPERATE these eight elementary processes would require more than a score of factories located at such points as economic factors would determine. These factories would draw upon the natural resources of Montana, New Mexico and Washington and would require enormous masses of thermal and electrical energy. They would produce products essential to the growth of apples in this state, citrus fruits in California, and sugar in Hawaii. Especially essential would these products be to subsistence farming on the lighter soils of western Washington and to growth of specialized crops as determined by the climatic advantages of this region.

When it came to making a living from our big trees—our principal resource here in western Washington and Oregon—quite a problem presented itself. It was evident that before these big trees can be marketed they must be broken down into smaller units. And so we break them down into boards and into bales of pulp. There is no large local market for either lumber or pulp, but these two articles are much needed on other portions of the globe and so we ship them to localities that require them. But the lumber industry is only 30 per cent efficient.

My thesis at this point is that in using these big trees for subsistence, we can break them down into still other units. In other words, wood is a raw material for chemical commodities. The various steps in a wood chemical industry are the following: (1) the use of stripped hemlock bark for solid tannin extract; (2) the making of solid cellulose tanning extract from waste sulphite liquor; (3) the use of logging waste to produce synthetic lumber by methods similar to the Masonite process; (4) the manufacture of wood flour and its use as a filler for such plastics as Bakelite; (5) the production of alcohol motor fuel from waste sulphite liquor or sawdust treated by the Bergius or some related process; (6) the preparation and distribution of waste sulphite liquor for road improvement; (7) the use of highly purified pulp (alpha cellulose) for transparent fruit wrappings and for textile purposes; (8) the production of cellulose acetate rayons, films and lacquers.

In these eight steps in a wood chemical industry we have a potential industry that will duplicate in dimensions the combined sawmill and pulp mill capacity

of this region. In addition to present wood wastes it will draw heavily upon electrical power, limestone, coke, sulphuric, nitric and hydrochloric acids, and coal tar products. It will produce a variety of products that will stimulate contacting industries and will replace many commodities which now reach us from more distant localities.

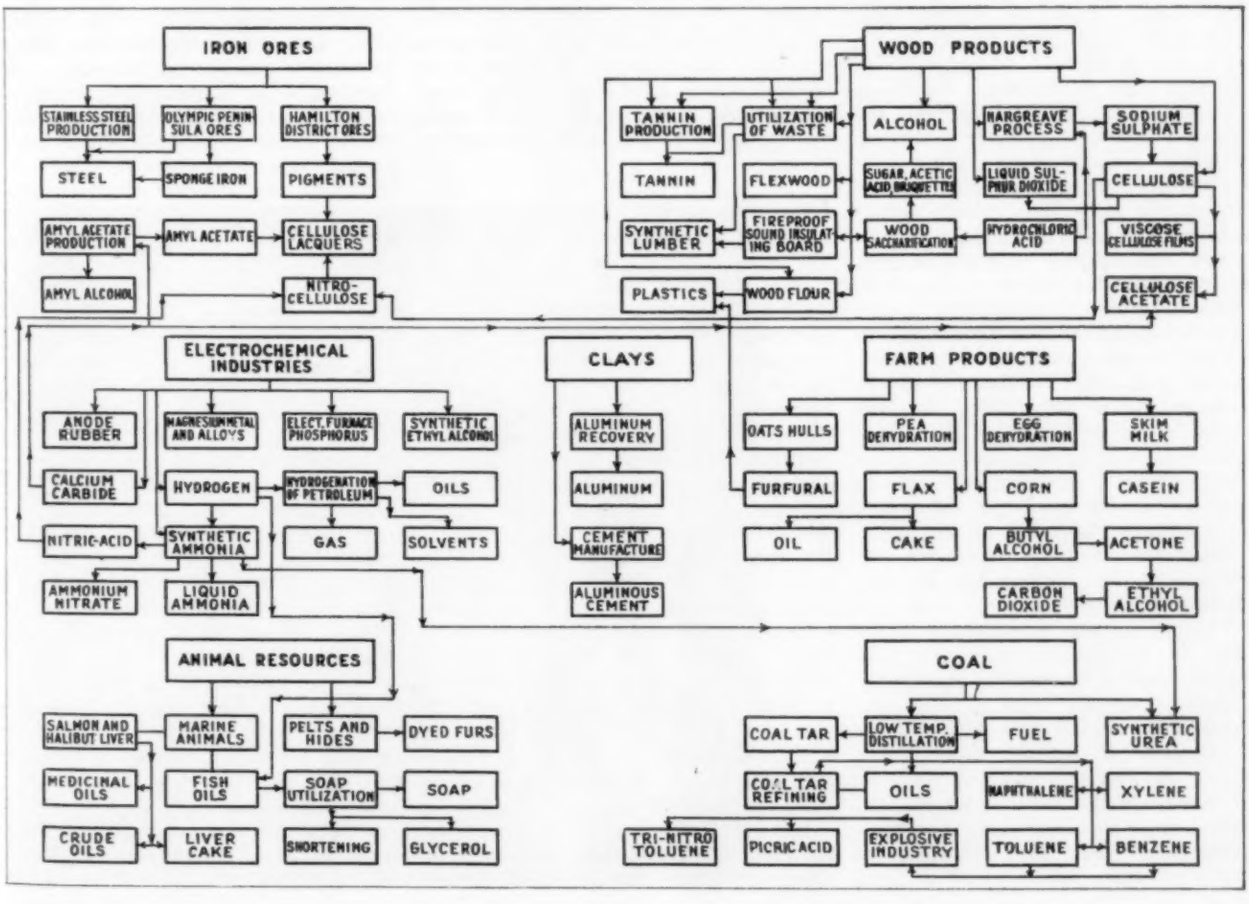
Having thus pointed out the untrodden chemical frontiers that lie before us in the use of our big trees, let us see if such an unexplored region also lies before us in breaking down, into convenient shipping units, the great masses of hydroelectric power soon to be our second great natural resource. Let us take first the carbide industries. With a reserve supply of 64,000,000,000 tons of bituminous coal presently available, the 200,000 hp. of electricity to be installed at Grand Coulee and Bonneville dams, calcium carbide, to my way of thinking, becomes the key chemical of the Pacific Northwest. The synthetic products now produced at Shawinigan Falls and at the plants of the Carbide and Carbon Chemicals Corp. have become a well-worn trail in chemical industry. In the interesting list of products, acetic acid and its anhydride are closely related to the alpha cellulose industry already in existence. Acetate rayons, lacquers, and plastics should be the resultant of the great stores of coal and electrical power for which no large market now exists.

A second method for the marketing of electrical power lies in the electrometallurgical field. The average annual value of mineral resources in the state is now in excess of $21,000,000. The electrolytic production of aluminum from imported bauxite or the development of new methods for its production from alunite in Utah; the electrothermal reduction of magnesium oxide from magnesite or the decomposition of magnesite by calcium carbide to form metallic magnesium; the production of ferrochrome, ferromanganese, and ferrosilicon in the electric furnace; and, finally, the making of stainless steel and other non-corrosive alloys in electric melting furnaces—all these are consumers of a great natural resource — electrical energy.

Besides our forest and hydroelectric resources there are other supporting backgrounds for chemical industries. Our water-borne imports and exports are in excess of $500,000,000 annually, while manufactured products aggregate over $1,000,000,000. Farm products amount annually to $100,000,000. The ports of Puget Sound serve a territory producing 35 per cent of the nation's lumber, 15 of its copper, 25 of its lead, 12½ of its wheat, 35 of its apples, 28 of its peas, 15 of its wool, and including Alaska, 35 per cent of its fishery products.

In addition to these resources of land and sea, another factor affecting the development of chemical industry in the state of Washington is that of plant location. It is a pleasant place in which to work and live. Already these ports are served by 84 steamship lines sailing to 245 ports. It has access to the raw materials of the world; the labor of its cities is intelligent, diversified, and efficient; from the snow clad slopes of the mountains the purest water supplies known are derived; wood waste and cheaply mined coal are abundant; hydroelectric power awaits development; hard surfaced highways connect every city and village; and in this region extremes of heat or cold rarely, if ever, cause industry to cease for even a moment in its labors. These favorable factors are prophetic of a future greatness which cannot be denied this region on the West Coast.

POTENTIAL CHEMICAL INDUSTRIES OF THE PUGET SOUND REGION



OREGON'S OPPORTUNITIES

LIE IN UNIQUE TRANSPORTATION PATTERN

By O. F. STAFFORD
Professor of Chemistry
University of Oregon
Eugene, Oregon

AT BUT ONE POINT within the area of the Western United States does a great river break through both the interior and coastal mountain barriers to the Pacific Ocean. It is the Columbia River-Snake River system which has this distinction. Two transcontinental railways take advantage of the water grade routes which this river system offers. Another railway comes up through the interior valleys from California and connects with others for Puget Sound and British Columbia. The Columbia is navigable for the largest ocean freighters for a hundred miles inland and offers the only first class harbor between San Francisco and Puget Sound. From this harbor great circle routes to all parts of the Pacific Basin are in general as favorable as from any other harbor upon the Coast. Accessibility to the East through the Panama Canal is obvious. It is this incomparable transportation pattern with its accompanying rate structure rather than strictly state lines which defines the Lower Columbia industrial province. Oregon lies entirely within this area and constitutes the major portion of it.

Served by this transportation system are activities based upon agriculture in its broadest sense, upon forest products, minerals and upon the fish life of the rivers and the ocean. Within the area to aid in processing all of these raw products is a superabundance of water power, much of it developed or in process of development and this too at points adjacent to both rail and ocean transportation lines.

Although the region has an embarrassment of riches with respect to raw materials out of which to make things to eat and to wear and with which to build, it is deficient, practically, in earth materials such as iron ore, bauxite, coal, oil and natural gas. Much of the area, it happens, was deeply covered in recent geological time by lava flows which effectually conceal the mineral deposits which may be there. Occasionally there are exposures of older formations which carry mineral deposits of economic importance. Out of these, in times past, much gold and silver have been taken and there still is some production of these metals. Oregon is one of the few localities upon this continent where mercury is produced in quantity. There are mines yielding lead, zinc, and copper, and also there are reputed deposits of chromium and manganese. Extraordinarily extensive deposits of diatomite of excellent quality exist and to some extent are being worked. Limestone is found in abundance only in the older geological formations of the extreme northeast and southwest corners of the state. Some of this limestone is marble of good quality. High-grade lignite is available abundantly at one point in Oregon, the Coos Bay region. Iron ore is to be had but it exists under conditions which make it improbable that it could ever support a significant iron-making industry.

IN SPITE of the deficiency of economically important earth materials in the immediate neighborhood of the Lower Columbia industrial area there need be no lack of those essential to electrochemical and electrometallurgical operations for the reason that facilities for transporting them from deposits existing elsewhere to the area in question are unusually favorable. Bordering the region upon the east there is a great wealth of phosphate rock, nonferrous metals, alunite, and other mineral products all of which logically can enter the channels of world trade by way of the Columbia River and receive due processing while en route. Coal and limestone can be secured as ship cargoes from not too distant sources. The region is one where exports by ship vastly exceed imports so that needed ferrous materials of whatever sort can be brought in as return cargoes at favorable transportation rates.

Industries based upon the processing of raw food materials do well in Oregon. All of the important cereals are available in abundance; the preeminence of Portland as a livestock market is a guarantee that the packing house industry can carry on. Tanning, as an adjunct to the animal products industry, is not well represented although an infinite amount of hemlock bark tannin is potentially available. Innumerable dairies furnish milk for cream, butter, cheese, and condensed milk but as yet there is no significant production of milk powder, milk sugar, or casein although the opportunities for establishing these industries certainly exist and much casein is consumed locally, in making plywood, for example.

No discussion of the food industry of Oregon would be complete without mention of the fishing industry. Outstanding in this connection is the salmon industry of the Columbia River and its tributaries, the produce of which has an annual value of the order of $15,000,000. Of lesser importance, but nevertheless very significant, is the business in ocean fish, clams, crabs, etc. Very recently a start has been made in the taking of pilchard from the sea. The pilchard industry heretofore has been active mostly off the California coast where the annual take is said to be of the order of 600,000 tons. The industry as contemplated for Oregon will utilize the fish for making oil for industrial use and food for poultry and stock. The oil has drying properties.

The timber stand in Oregon is in round numbers 400 billion feet, board measure, an amount greater than that in any other state and equivalent to about one fourth of all timber in the United States excluding Alaska. To this strictly state asset there should be added another 70 billion feet which is so situated in the Columbia Basin that it is essentially within the Oregon industrial area. This stand of timber is for the greater part located upon ground which is suitable for no other purpose than the growing of forest trees. Much of it is in National Forests, and therefore already subject to con-

trolled usage. The greatest yearly cut of record took less than 5 billion feet from these forests. The average cut during the past ten years is 3.6 billion board feet. The estimated yearly growth is greater than any demand that has as yet been made. The present stand of timber is equivalent to a 120-year supply at present average cutting rates. These facts indicate clearly that with reasonable reforesting there is an abundant perpetual supply of wood in the region.

An important outlet for much of the wood available in Oregon is in wood pulp and the things made from it. The varieties most suitable for pulp are western hemlock, Sitka spruce, Engelman spruce, white fir, amabilis fir, noble fir, alpine fir and mountain hemlock. The amounts of these in Oregon are of the order of 15 billion cubic feet; to this should be added something like 5 billion cubic feet as necessarily tributary to the Oregon industrial area although outside of the state boundaries. All authorities agree that the Pacific Coast has the growing capacity to produce for all time acceptable pulp woods for many more mills than there are at present. In quality these woods are all that could be desired. Western Hemlock is considered to be the equal of eastern spruce and in some respects, as in the making of alpha cellulose, it is perhaps superior. The other varieties included in the pulpwood inventory are all very acceptable. Available, but not included in the inventory, is the enormous supply of Douglas fir which at present is utilized in significant quantities in making kraft and fiber stock.

There are 15 paper and pulp installations in the Oregon area which is taken to include the Washington mills just across the Columbia River at Camas, Vancouver and Longview. The daily tonnage capacities of these plants in tons per 24-hour day is as follows:

	Tons
Mechanical pulp	815
Unbleached sulphite	690
Bleached sulphite	400
Sulphate	330
Total	2,235

	Tons
Newsprinte	485
Sulphites	445
Sulphates	255
Board	227
Total	1,412

The principal finished items are as follows: news, sulphite wrapping, poster, lightweight paper, sulphite bond, glassine, greaseproof, kraft wrapping, bag, fruit wraps, towels, binder board, fiber insulating board. These items are subclassified into a very large number of specialties. Further information regarding the pulp and paper industry appears in a special article of this series.

Conditions for the manufacture of textiles using wool, flax, and eventually rayon are ideal in Oregon. Wool and mohair are principal exports from the region although there is a very considerable local usage. Fiber flax of highest quality is grown and at present is shipped out principally as raw fiber to be fabricated elsewhere. Recently a single exportation of 2,000 tons of flax fiber was made to France for the manufacture of cigarette paper. Local flax fiber usage at present is limited to the making of toweling, yarn, fishing net cordage, etc.

There is at present no textile industry based on rayon, but with unlimited supplies of the very highest quality of alpha cellulose locally available and with other essentials also to be had as needed, the opportunity to establish the manufacture of rayon fabrics is entirely open. The climate of western Oregon is ideal for the carrying on of every kind of textile operation. Pure soft water is at hand without limit. Power is available at extraordinarily low prices. There is transportation by ship or by rail to every market of the world.

This favorable position of the Portland area in the transportation pattern of the world together with availability of unlimited power at very low rates opens the possibility for a further development of industries in which materials are processed in transit. Locally this idea is already in practical operation: lumber, wool, livestock, wheat, fruits and vegetables, all are to some extent processed on their way from points of production to eventual markets. Electrochemical and electrometallurgical industries which may take advantage of the cheap power available upon the Columbia of necessity will operate with raw materials in transit since unfortunately many of these materials are not to be had locally. A notable possibility is presented by the processing at Bonneville of phosphate rock from the inexhaustible supplies of this material existing in Idaho, Utah and Montana. The logical product in this case would seem to be ammonium phosphate.

Brubaker Aerial Surveys

Aerial view of Bonneville project with excavation under way in cofferdam on Oregon half of Columbia River channel. To the left, construction is proceeding on the power house and ship lock, while earth dams close Bradford Slough above and below

CALIFORNIA'S GROWTH

REFLECTED IN HER CHEMICAL INDUSTRIES

By GEORGE J. YOUNG
Consulting Editor,
Engineering & Mining Journal,
Berkeley, Calif.

CALIFORNIA, with a population of six millions, and with five million people in adjacent states, offers numerous opportunities for the process industries. Its growth has been most rapid, its people are energetic, the standard of living high. Well developed agriculture, lumbering, mining, and fisheries provide both raw materials and markets for chemical products. Ample low-cost power, good transportation and shipping facilities, and an abundance of oil and natural gas are basic and natural advantages. Certain statistics for 1933 (census) credit California with about 700 establishments in the process industries, and a gross value of over $400,000,000 in products. With exception of coke and rayon the important process industries are represented in the state. In order of importance they include: petroleum refining, lime and cement, oils and greases, paints and varnishes, chemicals and chemical preparations, ceramics, soap, paper and pulp, leather, drugs and cosmetics, glass, sugar, rubber goods, fertilizers, and explosives.

Other than gold, California does not produce any large tonnage of either ferrous or non-ferrous metals but its immediate neighbors are non-ferrous metal producers and Utah produces pig iron and coke. There are iron deposits but none of outstanding importance. Much study and thought have been given to the establishment of an iron industry and while there are enough favorable factors to intrigue, only one such establishment is in operation and iron and steel work is confined to fabrication and foundry work. Considerable quantities of steel and alloys are made in electric furnaces. Small and scattered deposits of chromite and manganese ores occur in the state and some scheelite is being produced. Quicksilver is produced in important quantities and some platinum metals are obtained in gold dredging. Electroplating was represented by some 44 establishments in 1933.

Coal deposits are unimportant but coal is shipped in from Utah and Washington, the principal fuels produced being natural gas and fuel oil. Industrial centers are now served with natural gas at low cost. The petroleum industry is of outstanding importance and both output and refining capacity have reached proportions where prorating of production and regulation are necessary to ameliorate ruinous competition. The crude oils produced range in gravity from 8 to 60 deg. Bé.; with some exceptions they are all of asphaltic base. Present production of crude from California oil fields approaches some 600,000 bbl. per day from which are obtained gasoline, kerosene, fuel and diesel oils, lubricants, asphalt, road oils, and coke; 48 refineries and 11 lubricating oil and grease plants were listed in 1933. In addition minor products such as cleaning fluids, fly sprays and insecticides are also produced, and liquid butane and compressed gases are marketed. Natural gas is compressed, freed from natural gasoline and delivered to pipe lines. One important oil company is engaged in the manufacture of synthetic nitrogen products.

SCATTERED limestone deposits, pure and dolomitic, are available in sufficient abundance to supply the requirements of the state. Pure limestone deposits are not numerous and some are not commercial for various reasons. However, the lime and cement industries are developed to the point where additional plant capacity is not needed now or for several years to come. Ordinary lime, hydrated lime, and lime of exceptional purity are produced. The last named is produced from oyster shell deposits in San Francisco bay. Eight modern cement plants, four in southern and four in northern California, serve the requirements of the state but only a fraction of plant capacity is now being used. Sulphate resisting, high-early, high silica and special oil-well cements are also manufactured.

Magnesite deposits are numerous but only in a few instances is commercial development feasible. Dead-burned and causticized magnesite are produced. Some magnesite is calcined for production of carbon dioxide which is compressed, the remaining magnesium oxide being manufactured into epsom salt. Hydrate and technical carbonate of magnesium are manufactured from the waters of San Francisco bay and fused magnesium oxide is produced in electric furnaces. Magnesium chloride is recovered from bitterns resulting from the manufacture of salt from sea water. The opinion is held by some that magnesium can and ultimately will be manufactured in California but this is now only a speculative opportunity. Potential productive capacity exceeds the market for magnesite at present.

Fire clay and other clay deposits in wide variety are numerous and well distributed. Greatest development has taken place in southern California but northern California has also shown substantial progress in the clay processing industries. Porcelain, tile, fire brick, architectural terracotta, sanitary ware, pottery, and the common brick and fired products are made. Commercially the clay industries have sufficient capacity for the needs of the region and further opportunities lie in the direction of special products and super refractories. Feldspar and kaolin deposits are rare but deficiencies are overcome by importations and the utilization of other materials and purer clays. A deposit of cyanite near Ogilby is being utilized by the Vitrefrax Corp. in the production of mullite in various grades. The same company is utilizing a "trachytic rock" for the manufacture of a ceramic base. A massive deposit of andalusite is mined in Mono county and shipped east to be used in the manufacture of spark plugs. The resources of the state in high aluminum silicates are still to be explored. Bleaching and bentonite clays occur and are being exploited to supply the requirements of the oil refineries. Opportunities lie in the direction of firebrick manufacture and of ceramic specialties of distinctive character and super refractoriness.

Silica, quartz, diatomite, pumice, and volcanic ash are abundant, but in many instances they do not meet exacting commercial requirements with respect to

purity, a fact brought out in the search for glass sand. Minor impurities and physical condition militated against some materials otherwise favorable. Washing, sizing, and chemical treatment, based on preliminary research, brought success and California now produces a considerable part of its glass sand. Abrasives for cleaning compounds are abundant and are exploited to a considerable extent, although the field offers further opportunities. Diatomite deposits of a commercial nature are comparatively few and these produce "filter aid" and heat insulating products in important quantities.

Commercial deposits of talc and soapstone are limited in number but those at present being exploited produce good grades and in sufficient quantities to supply the market. Many gypsum deposits occur, but commercial deposits appear to be restricted to the southern area, San Bernardino and Imperial counties. Plaster of paris, Keene's cement, and hard wall plasters are the principal products. A considerable tonnage of raw gypsum is shipped to the cement plants.

Deposits of sulphur and pyrite are few in number; sulphur-bearing concentrates are not utilized in acid plants but they could be so employed in instances where arsenic is not present. No sulphur deposits are producing at present, as the sulphur required by acid plants in southern California as well as other demands for sulphur are supplied by Texas and Louisiana. Two pyrite deposits in northern California supply the acid plants in the Bay area.

A number of barytes deposits are available and some are being worked. At El Portal quartz is being eliminated from an impure barite by jigging and the cleaned mineral is used in the production of pigment and for preparation of heavy muds employed in oil well drilling. The state appears to have sufficient resources in barite for its industrial needs. Barium chemicals are made at Modesto and lithopone near Oakland.

Although mineral pigment resources are not conspicuous at least one manufacturer has established a business in the San Francisco area, producing mineral pigments and heavy minerals for oil well drilling. There is little promise of expansion in this field. The paint and varnish field is represented by 84 establishments (1933) with an output valued at more than $16,000,000. Lead oxide pigments are made from pig lead and several corroding plants supply white lead. Zinc sulphide and oxide pigments are supplied from without the state but some lithopone and mixed lead and zinc oxides are produced within the state.

Production of salt, sodium and potassium compounds, boric acid and borates is an extremely important field. The natural resources in salines are impressive. Salt is principally produced by solar evaporation from sea water although there are playa deposits and some rock salt deposits as well. At Searles Lake potassium chloride, boric acid, borax, sodium sulphate, and trona are produced from brines. At Owen's Lake soda ash, and trona are obtained from saline crusts. The kernite deposits at Muroc represent an immense tonnage, sufficient to supply world demand for a number of years. In addition there are important deposits of celestite, strontium sulphate, but little has been produced. Calcium chloride is recovered in a few plants engaged in making salt from playa deposits. Sodium nitrate does not exist in commercial deposits and is imported. Some bromine and bromine compounds are produced from salt works bitterns.

Agricultural development in California is extensive and varied. Cereals, fruits, nuts, roots, and other crops are produced in quantities. Industrial alcohol is made at Agnews and Sausalito and at one time surplus raisins were used for its production. When alcohol receives serious consideration as an automotive fuel California will offer opportunities for the expansion of this industry. The wine industry is now developing and may be expected to supply its byproduct argols to the chemical industry. In the field of distilled liquors new opportunities are opening up. Waste lemons and oranges supply the byproduct plants producing citric acid and fruit salts. Beet culture is important and six large refineries produced sugar valued at $21,757,999 in 1933. One large refinery at Crockett receives raw sugar from Hawaii. Olives, cottonseed, sunflower seed, and some flaxseed are produced and serve the vegetable oil mills. A rubber which appears to possess certain distinctive properties is obtained from the guayule plant cultivated at a plantation near Salinas. Should this undertaking prove commercial an important new industry will have been established. California offers opportunities for the cultivation of medicinal plants such as cascara bark, yerba santa, belladonna, laurel, and peppermint. No doubt there are opportunities in the essential oil and perfumery fields.

Raising livestock is an important activity in California, supplying the process industries with animal fats, hides, hoofs, horns, bones, and tankage. Leather, gelatine and glue, bone meal and certain fertilizers are made in the state. The dairy industry is highly de-

Plant of the Great Western Electro-Chemical Co. at Pittsburg, Calif.

veloped. Wool is also an important product. Fishing and whaling are well established industries, assuring ample supply of edible fish, as well as fish oil, fish meal, and whale tankage for the fertilizer industry.

A considerable area of California is forested and trees are found in numerous varieties. While the lumbering industry is up-to-date there is no important chemical industry for utilizing wood products. A pulp mill was operated for a number of years at Floriston, but this has been shut down. An effort was made to manufacture pitch and turpentine and a wood distillation plant was operated for a few years but these activities have been discontinued. Some charcoal is made, but on a small scale, and eight wood preserving plants are in operation. At San Diego spray dried salts of alginic acid are made from kelp. During the War there was considerable activity in the chemical processing of kelp and its byproducts. At one time considerable eucalyptus oil was distilled but is probably now only produced on a restrictive scale.

The heavy chemical industries have been long established in California and commercial acid plant capacity is in considerable excess of demand. Other heavy chemicals are also abundantly produced. Four acid plants, utilizing Texas sulphur, are in southern California and three, utilizing pyrite produced locally, are in the San Francisco bay region. Nitric and hydrochloric acids are also produced in both localities. Caustic soda is in excess of any probable demand. Sodium sulphate, soda ash, tartrates and tartaric acid (from imported and some locally produced argols), ferrous sulphate, copper and aluminum sulphates and many other chemical compounds are produced. Nitrates are imported, but one nitrogen fixation plant is now operating near Pittsburg. Another electrochemical plant produces caustic soda, liquid chlorine, liquid sulphur dioxide, anhydrous ammonia, sodium and potassium xanthates, bleaching powder, iron and zinc chlorides, aqua ammonia and sodium hypochlorite. Sodium silicate is manufactured at two plants, one in the southern and the other in the northern area. Apart from specialties the field is very well served. In compressed and liquefied gases some 24 establishments were noted in the industrial survey of 1933.

Drugs, patent medicines and cosmetics are represented by numerous dealers and manufacturers both at Los Angeles and San Francisco. The field is one in which opportunities for small manufacturers and specialties exist to some extent.

Glass manufacturing is represented by 12 establishments (1933) bottle glass being the principal product. Glass sand, soda ash, lime, borax, and other materials produced in the state are used. It is of interest to know that most of the glass plants are using borax. The industry is well served but opportunities are excellent for other kinds of glass.

The tanning industry utilizes local hides and also imports hides. Most kinds of leather are produced and marketed. The paint industry is thoroughly developed and technically advanced, the larger companies operating their own corroding and oxide plants. Varnish materials are imported; much of the linseed oil is derived from imported seed; alcohols and solvents are in part produced by the state. The paper industry is active but no primary production of pulp is made. A large industry in paper board manufacture is established and utilizes old paper and rags. Composition roofing is represented by an exceedingly active group. Productive capacity is in excess of demand in practically all branches. Manufacture of rubber goods is a comparatively small industry but the tire industry is large. In 1933 both industries had an aggregate output of $24,868,655 worth of goods, over 80 per cent being tires and inner tubes.

In the 1933 survey the soap industry is represented by 32 establishments and a product of $13,343,327 value. Some of the largest soap manufacturers have plants within the state. Grease, tallow, and vegetable oils are in part supplied by the state and in part prepared from imported products. Caustic soda is supplied by California producers but some is derived from Puget Sound.

The fertilizer and insecticide process industries would appear to offer important opportunities for expansion in view of the agricultural development of the state. In citriculture the use of fertilizers has an established place but in other fruit crops there is yet no common acceptance. Both alfalfa and rice crops are systematically fertilized in some areas but much educational work is necessary. Shell Chemical Co. is now manufacturing synthetic nitrogen products and the abundance of electrical power suggests electrochemical and metallurgical applications. Gypsum and lime are abundant; phosphatic limestone is found in Idaho. It would appear that the important fertilizer constituents are available. Fertilizer statistics for 1933 indicate 22 manufacturers and about 80 dealers. In 1930 a total of 142,489 tons was marketed, in 1932 only 126,530 tons. In that year 18,407 tons of agricultural minerals was also marketed; in 1928 there were 64,008 tons of agricultural minerals sold. It would appear that something like 200,000 tons of fertilizer and 100,000 tons of agricultural minerals could be looked upon as a nearby objective of the potential field.

Insect pest control as well as weed control is an important activity in the agricultural and garden activities of the state and the opportunities for research and for expansion in demand are good. Poisons for rodent control are also marketed. Arsenic, thallium sulphate, cyanogen compounds, copper carbonate, lime, sulphur, and various organic poisons are used.

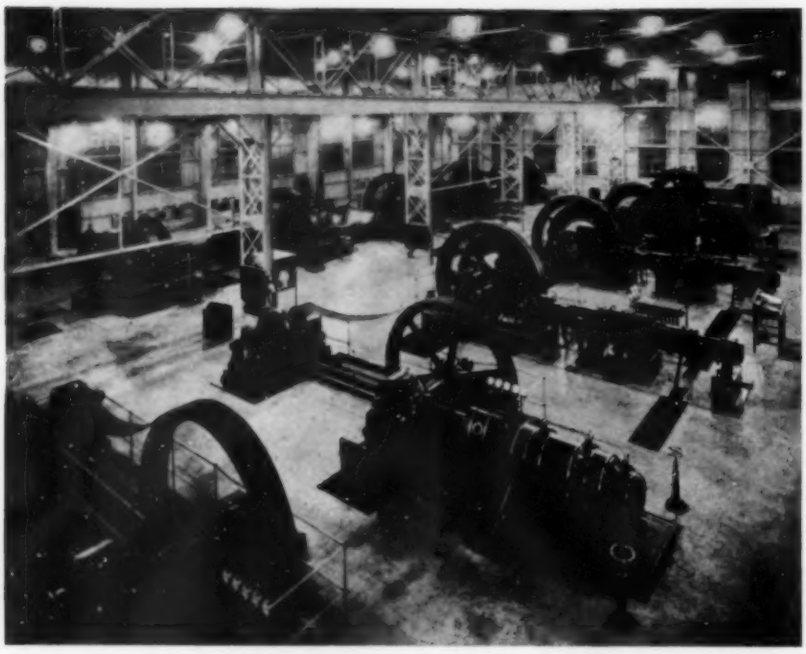
The vegetable oil industry is a promising field both from the agricultural and process standpoints. Present production of California is principally confined to olive oil, cottonseed oil, and linseed oil. The olive oil industry is an old one and takes the small fruit and the rejects from the ripe olive canning industry to make an edible oil. Cottonseed production could be expanded but proration activities interfere and seed is imported from Brazil, Egypt, and China. Flax culture is just beginning in the state and a production of about 800,000 bushels is expected in the current year. China and Argentina supply much of the flaxseed used in the vegetable oil industry of the state. Efforts are being made to encourage the cultivation of peanuts, and about 2,000 acres have been planted this year. Some sunflower seed is produced. Other oils such as copra, palm, mustard, kapoc, rape, hemp, perilla, and sesame are made from imported seed.

The near availability of power at low cost from the Boulder Dam project has stimulated discussion of the possibilities in process industries for the use of this power. Establishment of electrolytic copper and zinc refineries has been considered by some of the mining companies but no effort appears to be alive at the moment. In the field of artificial abrasives, calcium carbide, artificial graphite, ferroalloys, and magnesium metal there are possibilities, but also many obvious limitations. Synthetic ammonia appears to offer some promise at this time, but as the demands for ammonia and other nitrogen compounds for consumption on the Pacific Coast are modest and already satisfied the total amount of power that might be used in such work is not large.

California's position upon the Pacific enables its industries to draw upon tropical and semi-tropical products. Cocoa is imported and chocolate manufactured at San Francisco. Importations of raw coffee supply a number of coffee processing companies. Including the process industries a survey of the entire industrial field for 1933 indicated 8,429 separate establishments employing 191,861 wage earners and a total production reaching $1,488,181,331 in value. In such an industrial background it is obvious that many opportunities must exist that only particular study would discover. It is equally evident that the process industries are in a rich and fertile field.

Western Tools for Western Industry

NECESSITY has mothered not alone the spirit of invention but a certain resourcefulness and independence, which have led to many unique and striking advances in chemical engineering equipment in the West. Many of these are of but local interest while others have taken on national significance as the technology of western progress in mining and metallurgy, petroleum and paper, food and agriculture have spread throughout the country. These are reflected in the pages that follow.



HOW THE COAST FARES FOR PROCESS EQUIPMENT

By PAUL D. V. MANNING
Pacific Coast Editor
Chem. & Met.

EQUIPMENT for the process industries, available on the Pacific Coast, although by no means complete in variety, is entirely satisfactory and often unique in design and operation. The one real difficulty in handling western chemical engineering problems arises from the inadequate stocks that are available of nonferrous metals and alloy steels required in the fabrication of equipment.

With the excellent facilities in pattern shops, iron, steel and brass foundries and machine shops, certain types of equipment can be constructed quickly and at reasonable cost. Stainless steel and other alloy steel castings of almost any composition are produced in a great variety of sizes and shapes by a foundry which is one of the finest in the United States, in the opinion of eastern steel men. The practice of this particular establishment was developed mainly through work on large and complicated castings made for northwest paper mills.

In practically all work in which stainless steel or copper sheets and tubes are used, however, little stock is available and it is necessary to order from eastern mills. This often entails a delay of from 30 to 60 days before the materials arrive at the shop. There is no doubt that more alloy steels would be used in western construction if the metal stocks could be purchased locally. Sheet steel and tubes as well as alloy steel billets are generally to be had. Alloy steel forgings can be obtained quickly at a number of Pacific Coast points.

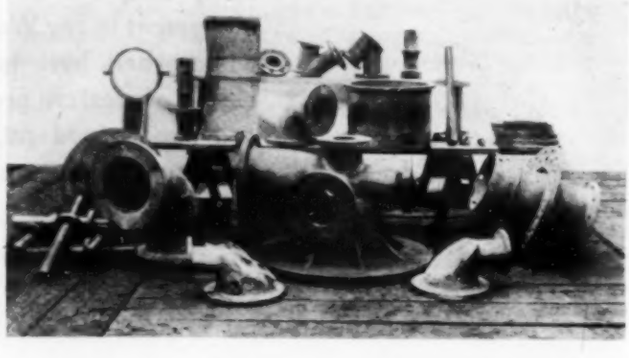
Several of the larger chemical engineering equipment concerns began business on the Pacific Coast and still maintain their principal factories there. These include Oliver United Filters, Inc., C. F. Braun & Co., and also the Byron Jackson Co. The Pacific Foundry Co., of San Francisco, was one of the earlier manufacturers of silicon-iron alloy products.

Other equipment makers originating on the Coast and now nationally known include the Lee B. Mettler Co., manufacturing gas burners, the Merco-Nordstrom Valve Co. and the Bingham Pump Co. The Mountain states, Colorado and Utah, are home territory for the plants of several of the larger process, metallurgical and mining equipment makers such as A. R. Wilfley & Sons, the Colorado Iron Works Co., the Mine & Smelter Supply Co., the Eimco Corp., the American Ball Mill Co. and the Galigher Co. Among the larger equipment fabricators of the Coastal region are the Pacific Tank & Pipe Co. and the Oakland Copper and Brass Works.

Unit operations equipment made on the Coast includes conveyors, trucks, containers, pumps, valves, grinders, pulverizers, kettles, tanks, agitators, rolls, perforated metal for screens, stills, electrostatic precipitating equipment, motors and electrical apparatus, evaporators, condensers, heat exchangers, distilling columns, cooling towers, dryers, ovens, furnaces, gears and power transmission equipment, boilers and economizers, flowmeters, control equipment, fans and blowers and dust collecting equipment.

One of the first of the Coast's chemical engineering equipment companies, the Western Precipitation Co., is largely responsible for the advances made in electrostatic precipitation of dust and has recently brought out a highly efficient type of multi-cyclone dust collector. The Peebles spray dryer is also a western development.

Byron Jackson Co. has specialized in the development of equipment to handle unusual and difficult pumping problems. One of its recent products is a new type of pump easily cleaned, which is especially useful in handling liquids at boiling points under high va-



Above: Compressor room, Shell Chemical Co., showing 11 synchronous - motor-powered compressors totaling 8,150 hp. (Electric Machinery Co.)

Right: Typical process machinery castings produced by Electric Steel Foundry Co., of Portland, Ore.

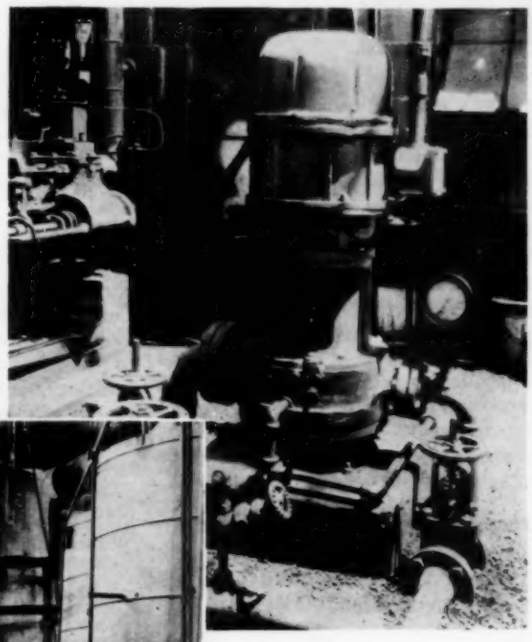
cua with very small suction submergence. Pumping problems in oil refining have given a fine impetus to research in this field and this has resulted in the application of centrifugal pumps at points heretofore deemed impossible, at extremely high pressures and temperatures.

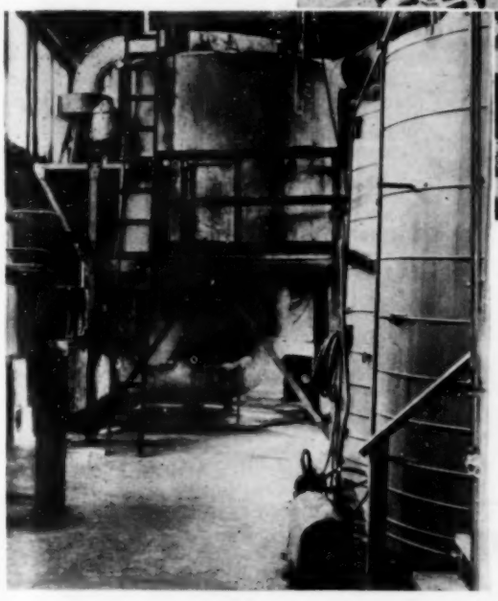
Many eastern manufacturers do not appear to realize the need of maintaining fully informed representation in the West. There are notable exceptions but, for the most part, when a prospect desires information relative to performance and price of a piece of chemical engineering equipment, he finds that the factory representative must write to the factory for essential information. In the correspondence, the problem is often misunderstood, with consequent further delay. This trouble could often be alleviated if manufacturers appreciated more fully the distances involved and gave prompter attention to western inquiries.

A new type of evaporator has recently been invented by David D. Peebles, of Eureka, Calif. This evaporator differs markedly from the one previously developed by Peebles. It was devised especially for handling easily injured organic liquids and, thus far, has been installed in multiple effect up to four effects. It is characterized by the small quantity of liquid in the apparatus at any instant and by the fact that the liquid being concentrated makes a single pass through the whole apparatus, leaving at the desired concentration within a few seconds after entering in the feed. No recirculation is permitted and no concentrated liquid can remain in the evaporator. Concentrations as high as 75 to 80 per cent solids have been attained in this way with certain liquids. Although most of the development work on this equipment has been completed within the last several years, large installations have already been made in California, Wisconsin, Washington, Honolulu and England.

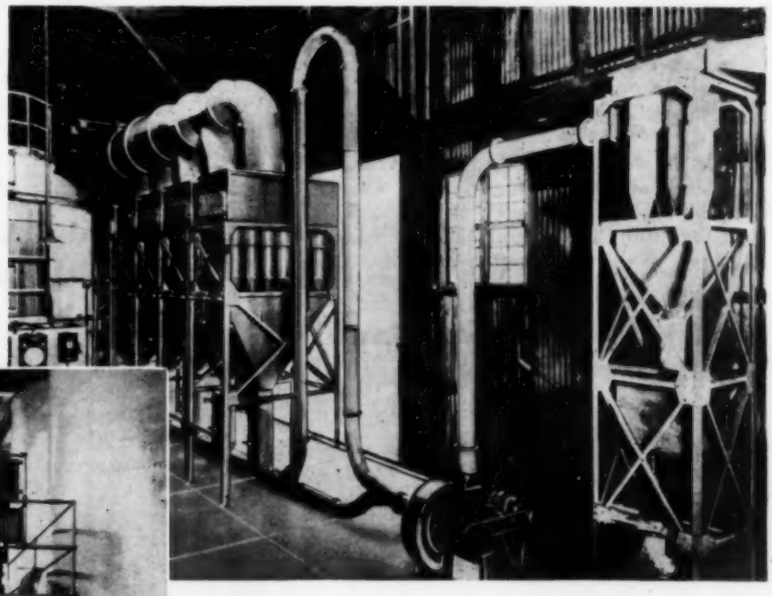
Right: Byron Jackson Hydropress pump in a large oil refinery; six stages, 100 g.p.m., 540 ft. head, 3,550 r.p.m., 20 hp.

Below: Peebles spray dryer for insecticides in the plant of the Westwell Chemical Co.

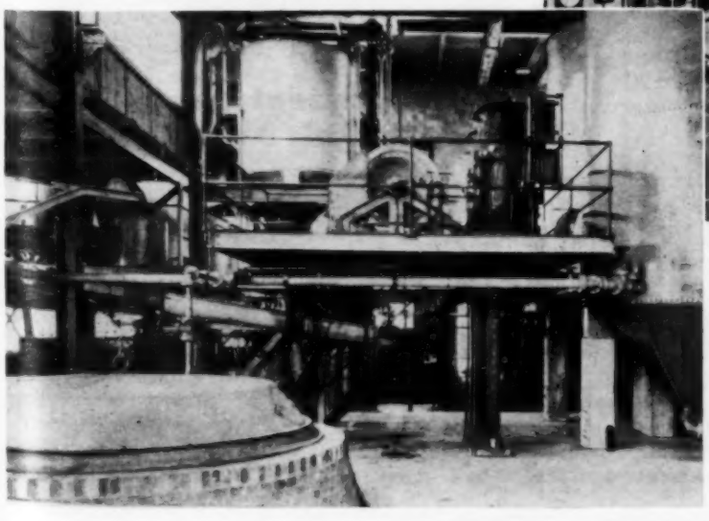




Multi-Clone dust collectors operating with a spray dryer



Caustic pot and flaking machinery, Tacoma Electrochemical Co.



Chemical Engineering NEWS

Electrochemists to Meet in Washington

PAYING its fourth visit to Washington, The Electrochemical Society, Inc., will hold its fall meeting in the nation's capital, Oct. 10-12, with headquarters at the New Willard Hotel.

"High Temperature Reactions" will be the subject under discussion at the sessions on Oct. 10. This will take on an international aspect as papers will be read which have been prepared by such authorities as Marcello Pirani of Berlin, H. George of the St. Gobain Laboratories, France, Otto Ruff of the Technische at Breslau, and Louis Ferrand of Paris.

On the evening of Oct. 10 the Acheson Medal will be presented to Frank J. Tone after which a reception will be held in honor of the medallist.

On Oct. 11 a session on wet and dry batteries has been arranged under the direction of Dr. George W. Vinal. In the afternoon visits will be made to government laboratories and departments.

For the evening of Oct. 11, Dr. C. E. K. Mees of the Eastman Kodak Co., will be the guest speaker at the joint meeting of all the scientific and technical societies of the Washington district.

Sodium Lights on San Francisco Bridge

THE largest and most spectacular installation of sodium lighting in the world will provide more than 8 million lumens of that new and highly efficient golden yellow illumination for the San Francisco-Oakland Bay bridge upon its completion, according to General Electric engineers, designers of the sodium-light equipment. More than 35 full moons would be required to give the same average intensity on the upper roadways of the double-deck spans as will be provided by this amount of sodium light.

A total of 922 G-E Novalux sodium luminaires will be supplied and will be used in 25 circuits strung along about 15 miles of roadways for the double-deck spans, the tunnel, and the approaches comprising the huge new link between San Francisco and Oakland.

On the upper deck of the bridges, to be used for passenger vehicles and other high-speed traffic, 6,720,000 lumens of 10,000-lumen sodium lamps will be installed, while 1,500,000 lumens of 6,000-lumen lamps will be used on the lower-deck for trucks and similar lower-speed traffic—a total of 8,220,000 lumens for the project, constituting by far the largest single order ever placed for this type of equipment.

A.C.S. at San Francisco

As this issue of *Chem & Met.* is about to go to press, members of the American Chemical Society are en route to San Francisco for the Ninetieth Meeting of the Society which will open on Aug. 19 and continue through Aug. 23. A report of the technical papers presented at the meeting will be published in our September issue.

Metal Congress Will Be Held in Chicago

OUTSTANDING leaders in the metal world will take an active part in the technical program for the Seventeenth National Metal Congress and Exposition, to be held in Chicago the week of September 30.

The Societies participating in the Metal Show are the American Society for Metals, the American Welding Society, the Wire Association, and the Institute of Metals Division and the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers.

In the course of some forty morning and afternoon sessions during the five-day period, more than seventy-five papers dealing with every phase of the metal industry, will be presented. Over a hundred subjects will be discussed by men whose names are synonymous with the latest developments in the science and art of metals.

There will be sessions devoted strictly to research and others dealing with practical shop problems, service tests of materials, melting practice, tool steels, and alloys. The program is so arranged that visitors to the Congress will be able to attend all the sessions in which they are particularly interested.

du Pont Will Build West Coast Plant

ANOTHER new plant is in prospect for the Pacific Coast according to a report that E. I. du Pont de Nemours & Co. will begin the production of paints, varnishes and lacquers, including Duco and Dulux, to supply the West Coast territory, in a plant, construction of which will begin immediately in South San Francisco. The company has just concluded negotiations for a site at Linden Ave. and the South Pacific Railroad, and the company's engineers are ready with plans for the first unit. The plans for this unit call for one main building, varnish sheds, and smaller structure for tank storage and the like.

Crown Zellerbach Research Division

ANNOUNCEMENT has been made by Crown Zellerbach Corp., Camas, Wash., of the formation of a development and research department as a new division. This department will be comprised of the technical departments of each operating unit. Dr. E. C. Lathrop will be the head of this department as technical director of the corporation. This step is taken in order to unify and coordinate the extensive development, research and quality control activities of the various divisions. Dr. Lathrop's headquarters will be at the Camas Mill of the Crown Willamette Paper Co. of which he is also technical director.

Chemical Show Will Exhibit New Products

AT the last Exposition of Chemical Industries held in 1933, The American Chemical Society placed on display a group of chemical products which had been developed during the depression period and which were described as "Children of Depression." At the next exposition which will be held at the Grand Central Palace, New York in December, the Society will again have an exposition of new chemical products which have been evolved since 1933 and which are to be labeled "Children of Recovery."

NEWS FROM WASHINGTON

WITH business again decidedly on the upgrade, government economists expect the third time to be the charm. Two years ago the recovery was a flash in the pan caused by fear of inflation. Last year it was caused by the scramble to build up inventories. The present upturn is broader than either of its predecessors and apparently goes to the consumer. The larger buyers seem to have deferred maintenance and other purchases as long as they can. They are being importantly seconded by the natural extravagance of the American people who have decided that the worst is over and who have given up any thoughts they may have had of tightening their belts.

One of the deterrents to recovery has been the agitation of a wide variety of reforms. Business now realizes that the reform program likely to be enacted into law has about run its course and that little additional burden of that character need be carried. Improving conditions in other countries also is seen as helping the domestic situation.

Central Statistical Board

In signing the bill giving permanent statutory existence to the Central Statistical Board the President is understood to feel that an important step forward has been taken in providing a clearing house for the extensive statistical activities of the government. It is not only a clearing house for what is done in the way of statistics, but also for ideas as to what should be done. It has demonstrated its usefulness in promoting coordination and in preventing duplication. It improves statistical technique and interpretation.

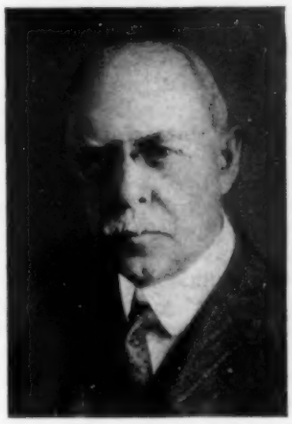
There is a feeling that Maurice Copeland, the acting director, should be made director, since Dr. Edmund E. Day has indicated that he is not in a position to accept the appointment.

Republican members of the Senate are in a position to delay passage of the tax bill for at least six weeks. Some of them think no other such favorable opportunity to develop good campaign material will develop. They are anxious to fight it every foot of the way making speeches for the Record as they go. They want to get together concrete examples to show just what the bill will do to specific communities and what its effects will be on small as well as on large industries. Such analysis as has been made indicates that profitable small industries will suffer more than large ones. While the small industry will get some reduction in income tax, that saving will be more than offset by the excess profits tax. The small concern with no wide market for its stock will be hurt more than those widely owned whose alleged capital is large.

Efforts to amend the Copeland food and drug bill to exempt containers of medicinal chemicals from the requirement of labeling plainly and conspicuously with complete and adequate directions for use of the product are being made by chemical interests.

Appearing before the House Interstate and Foreign Commerce committee, which held hearings on the bill in that body, Warren Watson, Washington representative of the Manufacturing Chemists Association, urged an amendment to Section 402 (g) of the bill. This Section provided that a drug would be misbranded if its label failed to bear "plainly and conspicuously complete and adequate directions for use." Declaring that the provision was impractical and contrary to public interest, Mr. Watson explained that chemicals such as potassium iodide, atropine sulphate and others have such a number of medicinal and commercial uses that it would be impractical to give complete and adequate directions for use on their containers.

Arthur D. Little Dies



A. D. Little

Arthur D. Little is dead. He died suddenly on Aug. 1, of a heart attack, in Northeast Harbor, Me., where he was spending the summer with Mrs. Little. He had not been in the best of health in recent months. In fact, since he relinquished the presidency of his company last February to become chairman of the board of Arthur D. Little, Inc., he had begun to take things a little easier, although continuing his active interest in chemical engineering. From Phoenix, Ariz., where he spent some time last winter, he wrote to *Chem. & Met.*, in April, enthusiastically approving the plan for the second award for chemical engineering achievement. His loss will be keenly felt by the entire profession.

To review a life that has been so productive is scarcely possible here. Despite his many great accomplishments, it is significant that in his own opinion his chief contribution to the welfare of his fellow-men was in "preaching the gospel of industrial research." In this capacity as a powerful exponent of science and technology, he was always distinguished by his precise and forceful use of the written word. Two of his books, "The Handwriting on the Wall" and "The Fifth Estate," probably did more than any others to interpret chemistry and chemical engineering to the business man. The latter drew its title from Dr. Little's classical address at the Franklin Institute Centennial when he defined as the Fifth Estate "the company of thinkers, workers, expounders and practitioners upon which the world is absolutely dependent for the preservation and advancement of that organized knowledge we call Science." (See *Chem. & Met.*, Oct. 6, 1924, pp. 534 ff.)

Dr. Little significantly influenced the type of chemical engineer in industry as a result of his interest in chemical engineering education. He was largely responsible for outlining the present course of his alma mater, Massachusetts Institute of Technology, and he founded its school of chemical engineering practice. As chairman of the committee on chemical engineering education for the American Institute of Chemical Engineers in 1922-24 he initiated much of the constructive work that has since been accomplished by that organization.

Dr. Little was president of the American Chemical Society (1912-14), American Institute of Chemical Engineers (1919) and the Society of Chemical Industry of London (1928-29). He was awarded the Perkin medal in 1931.

Born in Boston, Dec. 15, 1863, Dr. Arthur Dehon Little began his practice of chemical engineering there in 1886 directly following his graduation from M.I.T. His first company was a partnership with Roger B. Griffin, who was killed in an accident in 1893. A new partnership was formed in 1900 with the late Col. William H. Walker which continued until 1909 when the latter became head of chemical engineering at M.I.T. The business of Arthur D. Little, Inc., was incorporated in 1909 and moved to its present location in Cambridge in 1917.

The MARKETS

MOST of the industries which are large consumers of chemicals have held up very well during the hot-weather period and deliveries of chemicals have gone forward in a very satisfactory way. It is true that shipping instructions for August delivery were not so numerous as those for the months immediately preceding but the rate of decline was not severe and optimistic reports are fairly general regarding the outlook for business during the fall months.

The price trend for chemicals has not been pronounced although some commodities were marked up during the past month. The majority of selections, however, are distinguished by a steadiness in price with no trend in either direction. Vegetable oils and animal fats, on the other hand have followed a downward price curve and may continue in that direction for another month.

Naval stores weakened in price early in this month following a notification from Washington that pending enactment of the A.A.A. amendments, government loans to producers of gum rosin and gum turpentine have been suspended.

Acting Secretary of Agriculture Tugwell announced that he had signed an order suspending the licenses for agents, commission merchants, distributors and factors of gum rosin and turpentine, effective at noon August 5.

"Also," his announcement said, "the provisions of the license for gum turpentine and gum rosin processors which relate to the use of marketing tags will be suspended, while the rosin processors will be terminated, both effective August 5 at 12:01 A.M. The remainder of the agreement and licenses for the gum turpentine and rosin processors will remain in effect."

The Department of Commerce has just published a summary of recent developments in foreign markets. Among other things this states that the outlook for American coal-tar pitch exports to Germany are unfavorable owing to the existence of heavy stocks, and that Germany is shifting naval stores purchases away from the United States to European countries, particularly Russia. German exports of bronze powder are being stimulated by further price cuts.

Reports from other European countries show the following chemical developments: Construction of five new industrial alcohol plants in Ireland; a new synthetic resin plant has commenced operation in Erith, England; Russia has started production of carbon black in Baku; a new corporation has been formed in Hungary for the production of lactic acid; France's efforts to reorganize and operate a compensation fund for the naval stores industry have not been successful.

Reports from the Far East indicate that in India the largest domestic producer of sea salt has opened a new plant for the production of magnesium sulphate; that Japan has almost monopolized China's import trade in calcium chloride; and that a new company with a capital of 100,000 yen has been formed in Japan for the manufacture of photographic chemicals.

Argentina has substantially increased exports of animal byproducts since the beginning of 1935 and imports of sodium bichromate are increasing as a result of heavier arrivals from Russia. May exports of quebracho extract from Argentina showed further contraction.

Imports of red lead into the Philippines have declined owing to the increased use of ready mixed paints, and that country is now producing, in one factory, more than two-thirds the domestic demand for matches.

The chemical industry throughout the last five years has held a position relatively higher than that reported for all industry. From the data now available it is evident that the chemical industry in the first half of the present year has made appreciable gains over the corresponding period of last year.

General business activity during June registered a slight improvement over the preceding month and remained considerably above the levels of the corresponding month of 1934, according to the National Industrial Conference Board. In the field of production, greater-than-seasonal rises were reported by the construction, petroleum, coal, electric power, and machine tool industries. Distribution, as represented by miscellaneous freight traffic and retail sales, showed considerable improvement over that reported for May, 1935.

Industrial activity during the first six months of the year was markedly greater than during the corresponding period of last year. Of the more important indexes of production and of distribution only two—total carloadings and steel production—were lower during the first half of 1935 than a year ago.

Substantial gains have been registered in residential building, in automobile production, and in orders for machine tools. Demand for these goods is highly cyclical in character and the impressive rise of the past six months indicates that the shortages which have long been known to exist in such durable consumers' goods as houses and automobiles and in production machinery are at last beginning to make themselves felt.

Export figures for June, the latest available, show no indications that Italy is making large purchases of munition chemicals in this country in anticipation of a war with Ethiopia.

Some observers here are of the opinion that whatever large purchases of chemical raw materials Italy may be making is being done in Germany because of political reasons. Another factor that is being pointed out as a probable barrier to Italian purchases in this country is the Johnson Act which prohibits American banks from floating securities of a country that is in default on its obligations to the United States.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	87.56
Last month	87.23
August, 1934	87.61
August, 1933	86.26

The steadier position of sulphate of ammonia combined with higher sales schedules for denatured alcohol tended to bring up the price level and the weighted index number was slightly higher.

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	85.10
Last month	87.51
August, 1934	62.97
August, 1933	64.98

The price trend continued downward with animal fats playing an important part in reducing the index number. The paint-making oils held fairly steady but most other vegetable oils were weaker.

Current PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Aug. 9.

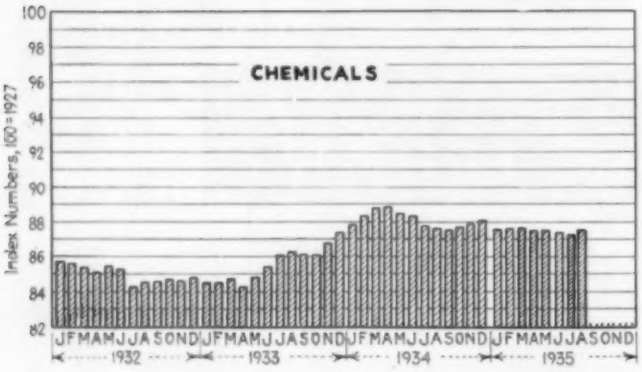
Industrial Chemicals

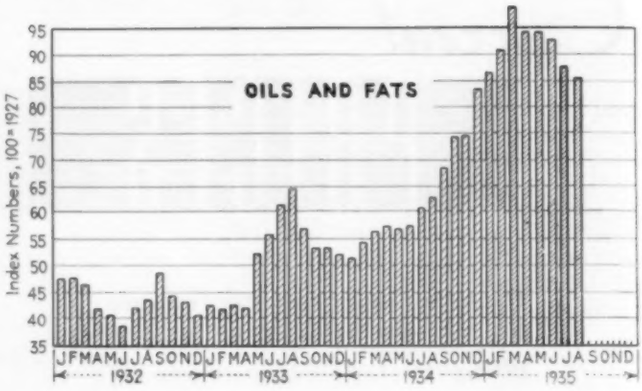
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.12 –$0.12½	$0.12 –$0.12½	$0.11 –$0.11½
Acid, acetic, 28%, bbl., cwt.	2.45 – 2.70	2.45 – 2.70	2.76 – 2.90
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	9.13 – 9.38
U. S. P. reagent	10.52 –10.77	10.52 –10.77	10.52 –10.77
Boric, bbl., ton	105.00–115.00	105.00–115.00	95.00–105.00
Citric, kegs, lb.	.28 – .31	.28 – .31	.28 – .31
Formic, bbl., ton	.11 – .11½	.11 – .11½	.11 – .11½
Gallic, tech., bbl., lb.	.60 – .65	.60 – .65	.60 – .65
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb.	.12 – .12½	.12 – .12½	.11½ – .12
22%, tech., light, bbl., lb.	.06½ – .07	.06½ – .07	.06 – .06½
Muriatic, 18° tanks, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –	18.50 –20.00
Oxalic, crystals, bbl., lb.	.11½ – .12½	.11½ – .12½	.11½ – .12½
Phosphoric, tech., c'boys., lb.	.09 – .10	.09 – .10	.09 – .10
Sulphuric, 60°, tanks, ton	11.00 –11.50	11.00 –11.50	11.00 –11.50
Sulphuric, 66°, tanks, ton	15.50 –	15.50 –	15.50 –
Tannic, tech., bbl., lb.	.23 – .35	.23 – .35	.23 – .35
Tartaric, powd., bbl., lb.	.24 – .25	.24 – .25	.26 – .26½
Tungstic, bbl., lb.	1.50 – 1.60	1.50 – 1.60	1.40 – 1.50
Alcohol Amyl			
From Pentane, tanks, lb.	.15 –	.15 –	.14½–
Alcohol Butyl, tanks, lb.	.13 –	.13 –	.09½–
Alcohol, Ethyl, 190 p'f., bbl., gal	4.27½–	4.27½–	4.15½–
Denatured, 190 proof			
No. 1 special, dr., gal.	.36 –	.36 –	.346–
No. 5, 188 proof, dr., gal.	.35½–	.35½–	.34 –
Alum, ammonia, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Chrome, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Potash, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Aluminum sulphate, com., bags cwt.	1.35 – 1.50	1.35 – 1.50	1.35 – 1.50
Iron free, bg., cwt.	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Aqua ammonia, 26°, drums lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Ammonia, anhydrous, cyl., lb.	.15½– .16	.15½– .16	.15½– .16
tanks, lb.	.04¾–	.04½–	.04½–
Ammonium carbonate, powd tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt.	1.20 –	1.175–	1.25–
Amylacetate tech., tanks, lb.	.14½–	.14½–	.14½–
Antimony Oxide, bbl., lb.	.10½– .12	.11½ – .12	.08½– .09
Arsenic, white, powd., bbl., lb.	.03½– .04	.03½– .04	.04 – .04½
Red, powd., kegs, lb.	.15½– .16	.15½– .16	.15 – .15½
Barium carbonate, bbl., ton	56.50 –58.00	56.50 –58.00	56.50 –58.00
Chloride, bbl., ton	72.00 –74.00	72.00 –74.00	74.00 –75.00
Nitrate, cask, lb.	.08½– .09	.08½– .09	.08½– .09
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks. drums, cwt.	1.90 – 2.00	1.90 – 2.00	1.85 – 2.00
Borax, grain, bags, ton	44.00 –49.00	44.00 –49.00	40.00 –45.00
Bromine, cs., lb.	.36 – .38	.36 – .38	.36 – .38
Calcium acetate, bags	2.10 –	2.10 –	2.50 –
Arsenate, dr., lb.	.06 – .07	.06 – .07	.05 – .06
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	20.00 –33.00	20.00 –33.00	17.50 –
flake, dr., del., ton	22.00 –35.00	22.00 –35.00	19.50 –
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Tetrachloride drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Chlorine, liquid, tanks, wks., lb.	2.00 –	2.00 –	.0185–
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.39 – 1.45	1.35 – 1.40	1.35 – 1.40
Copperas, bgs., f.o.b. wks., ton	14.00 –15.00	14.00 –15.00	14.00 –15.00
Copper carbonate, bbl., lb.	.08½– .16	.08½– .16	.08½– .16
Cyanide, tech., bbl., lb.	.37 – .38	.37 – .38	.37 – .38
Sulphate, bbl., cwt.	3.85 – 4.00	3.85 – 4.00	3.85 – 4.00
Cream of tartar, bbl., lb.	.16½ .17	.16½– .17	.19½– .20
Diethylene glycol, dr., lb.	.16½– .20½	.16½– .20½	.14 – .16
Epsom salt, dom., tech., bbl., cwt.	2.10 – 2.15	2.10 – 2.15	2.10 – 2.15
Imp., tech., bags, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Ethyl acetate, drums, lb.	.08½–....	.08½–....	.08½–....
Formaldehyde, 40%, bbl., lb.	.06 – .07	.06 – .07	.06 – .07
Furfural, dr., contract, lb.	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, crude, drums, gal.	.75 –	.75 –	.75 –
Refined, dr., gal.	1.25 – 1.30	1.25 – 1.30	1.25 – 1.30
Glaubers salt, bags, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Glycerine, c.p., drums, extra, lb.	.14 – .14½	.14 – .14½	.13½– .14
Lead:			
White, basic carbonate, dry casks, lb.	.06½–....	.06½–....	.06½–....
White, basic sulphate, sck., lb.	.06 –....	.06 –....	.06 –....
Red, dry, sck., lb.	.06½–....	.06½–....	.06½–....
Lead acetate, white crys., bbl., lb.	.10½– .11	.10½– .11	.10½– .11
Lead arsenate, powd., bbl., lb.	.09 – .10	.09 – .10	.07 – .09
Lime, chem., bulk, ton	8.50 –....	8.50 –....	8.50 –....
Litharge, pwd., csk, lb.	.05½–....	.05½–....	.05½–....
Lithophone, bags, lb.	.04½– .05	.04½– .05	.04½– .05
Magnesium carb., tech., bags, lb	.06 – .06½	.06 – .06½	.06– .06½
Methanol, 95%, tanks, gal.	.33 –....	.33 –....	.33 –....
97%, tanks, gal.	.34 –....	.34 –....	.34 –....
Synthetic, tanks, gal.	.35½–....	.35½–....	.35½–....
Nickel salt, double, bbl., lb.	.12½– 13	.12½– .13	.11½– .12
Orange mineral, csk., lb.	.09½–....	.09½–....	.09½–....
Phosphorus, red, cases, lb.	.44 – .45	.44 – .45	.45 – .46
Yellow, cases, lb.	.28 – .32	.28 – .32	.28 – .32
Potassium bichromate, casks, lb.	.07½– .08½	.07½– .08½	.07½– .08½
Carbonate, 80-85%, calc. csk., lb	.07 – .07½	.07 – .07½	.07 – .07½
Chlorate, powd., lb.	.08½– .09	.08½– .09	.09½– .10
Hydroxide (c'stic potash) dr., lb.	.06½– .06¾	.06½– .06¾	.07½– .08
Muriate, 80% bgs., ton	22.00 –....	22.00 –....	22.00 –....
Nitrate, bbl., lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb.	.18 – .19	.18 – .19	.18 – .19
Sal ammoniac, white, casks, lb.	.04½– .05	.04½– .05	.04½– .05
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 –....	1.23 –....	1.23 –....
Dense, bags, cwt.	1.25 –....	1.25 –....	1.25 –....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 – 3.00	2.60 – 3.00	2.60 – 3.00
Acetate, works, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl., cwt.	1.85 – 2.00	1.85 – 2.00	1.85 – 2.00
Bichromate, casks, lb.	.05½– .06½	.05½– .06½	.05½– .06½
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	14.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06½	.06½– .06½	.06½– .06½
Chloride, tech., ton	12.00 –14.75	12.00 –14.75	12.00 –14.75
Cyanide, cases, dom., lb.	.15½– .16	.15½– .16	.15½– .16
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., lb.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	3.25 – 3.40	3.25 – 3.40	3.25 – 3.40
Nitrate, bags, cwt.	1.275–....	1.275–....	1.35 –....
Nitrite, casks, lb.	.07½– .08	.07½– .08	.07½– .08
Phosphate, dibasic, bbl., lb.	.023– .024	.022– 0.24	.021– .023
Prussiate, yel. drums, lb.	.11½– .12	.11½– .12	.11½– .12
Silicate (40° dr.) wks cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60-62%, dr., lb	.02½– .03½	.02½– .03	.02½– .03
Sulphite, cyrs., bbl., lb.	.02½– .02½	.02½ .02½	.02½– .02½
Sulphur, crude at mine, bulk, ton	18.00 –....	18.00 –....	18.00 –....
Chloride, dr., lb.	.03½– .04	.03½– .04	.03½– .04
Dioxide, cyl., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl. lb.	.56 –....	.54 –....	.56 –....
Crystals, bbl., lb.	.39 –....	.38½–....	.38½–....
Zinc chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05½– .06
Carbonate, bbl., lb.	.09½– .11	.09½– .11	.09½– .11
Cyanide, dr., lb.	.36 – .38	.36 – .38	.38 – .42
Dust, bbl., lb.	.063– .07	.063– .07	.07 – .07½
Zinc oxide, lead free, bag, lb.	.05½–....	.05½–....	.06½–....
5% lead sulphate, bags, lb.	.05¼–....	.05½–....	.06½–....
Sulphate, bbl., cwt.	2.75 – 3.00	2.75 – 3.00	3.00 – 3.25

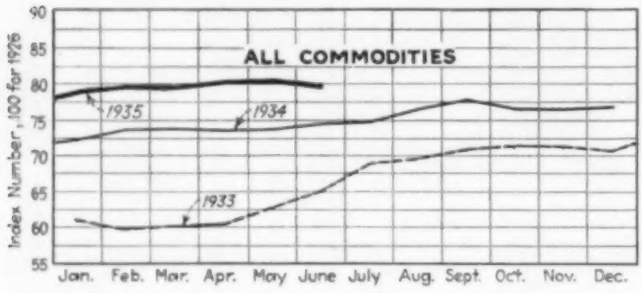
Oils and Fats

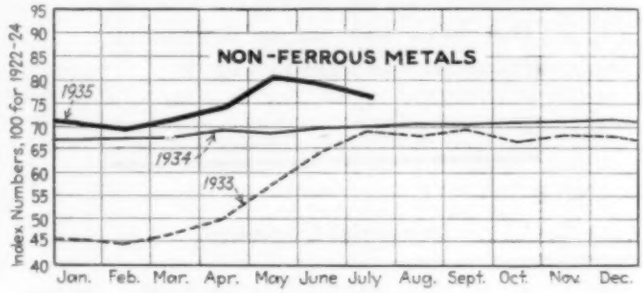
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½–$0.10	$0.09½–$0.10	$0.09½–$0.10
Chinawood oil, bbl., lb.	.15½–....	.15 –....	.09 –....
Coconut oil, Ceylon, tanks, N. Y. lb.	.03½–....	.03½–....	.02½–....
Corn oil crude, tanks, (f.o.b. mill), lb	.08½–....	.08½–....	.05½–....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.08½–....	.08½–....	.05½–....
Linseed oil, raw car lots, bbl., lb.	.089–....	.093–....	.072–....
Palm, casks, lb.	.04½–....	.04½–....	.03½–....
Palm Kernel, bbl., lb.	.05½–....	.05½–....	.03½–....
Peanut oil, crude, tanks (mill), lb.	.08½–....	.09½–....	.05½–....
Rapeseed oil, refined, bbl., gal.	.42 – .43	.42 – .43	.37 – .38
Soya bean, tank, lb.	.08 –....	.093–....	.06½–....
Sulphur (olive foots), bbl., lb.	.08 –....	.08 –....	.07½–....
Cod, Newfoundland, bbl., gal.	.35 –....	.35 –....	.40 –....
Menhaden, light pressed, bbl., lb;	.065–....	.067–....	.051–....
Crude, tanks (f.o.b. factory), gal.	.28 –....	.28 –....	.18 –....
Grease, yellow, loose, lb.	.04½–....	.06½–....	.03½–....
Oleo stearine, lb.	.08½–....	.09 –....	.06½–....
Red oil, distilled, d.p. bbl., lb.	.09½–....	.09½–....	.07 –....
Tallow, extra, loose, lb.	.05½–....	.06½–....	.04½–....

CHEM. & MET.'S WEIGHTED PRICE INDEXES









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.14½- .15
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Benzol, 90% tanks, works, gal.	.15 - .16	.15 - .16	.19 - .20
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb.	.11 - .11½	.11 - .11½	.11- .11½
Cresylic acid, 97%, dr., wks., gal	.45 - .46	.42 - .43	.50 - .51
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.	.05½- .06½	.05½- .06½	.06 - .07
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Phenol, U.S.P., drums, lb.	.14½- .15	.14½- .15	.14½- .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal.	1.10 - 1.15	1.10 - 1.15	1.10 - 1.15
Resorcinal, tech., kegs, lb.	.65 - .70	.65 - .70	.65 - .70
Salicylic acid, tech., bbl., lb.	.40 - .42	.40 - .42	.40 - .42
Solvent naphtha, w.w., tanks, gal	.26 -.....	.26 -.....	.26 -.....
Toluidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.30 -.....	.30 -.....	.30 -.....
Xylene, comm., tanks, gal.	.30 -.....	.30 -.....	.26 -.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb.	.10½- .13	.11½- .13	.12 - .13
China clay, dom., f.o.b mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 - .20	.04 - .20	.04 - .20
Prussian blue, bbl., lb.	.36½- .38	.36½- .38	.35½- .37
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb.	.26 - .27	.26 - .27	.26 - .27
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	4.00 - 4.40
Para toner, lb.	.80 - .85	.80 - .85	.80 - .85
Vermilion, English, bbl., lb.	1.52 - 1.55	1.52 - 1.55	1.58 - 1.60
Chrome yellow, C. P., bbl., lb.	.15 - .16	.15 - .15½	.15 - .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb.	.09 - .10	.09 - .10	.06 - .08
Manila, bags, lb.	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb.	.15½- .16	.15½- .16	.16 - .16½
Kauri No. 1 cases, lb.	.20 - .25	.20 - .25	.45 - .48
Kieselguhr (f.o.b N.Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	50.00 -.....	50.00 -.....	40.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	5.05 -.....	5.60 -.....	5.55 -.....
Turpentine, gal.	.43	.48½-.....	.48 -.....
Shellac, orange, fine, bags, lb.	.25 -.....	.25 -.....	.35 -.....
Bleached, bonedry, bags, lb.	.21 - .22	.21 - .22	.32 - .33
T. N. bags, lb.	.14- .15	.14 - .15	.26 - .27
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b N Y.), ton	13.75 -....	13.75 - . .	13.75 -.....

INDUSTRIAL NOTES

GUSTAVUS J. ESSELEN, INC., has moved its laboratories and offices to larger quarters at 857 Boylston St., Boston, Mass.

THE HYDRAULIC PRESS MANUFACTURING Co., Mount Gilead, Ohio, has established a sales office at 2842 West Grand Blv'd., Detroit. Reider Thoreson is in charge of the office.

LINK-BELT Co., Shovel and Crane Division, Chicago, has appointed Henry A. Petter Supply Co., Paducah, Ky., as distributors.

STEPHENS-ADAMSON MFG. Co., Aurora, Ill., has appointed L. R. Veatch to handle sales and engineering of its products in the Buffalo territory.

FERRO ENAMEL CORP., Cleveland, has sent C. D. Clawson, former export manager, to Brazil where he is acting as managing director of Ferro's new plant at Sao Paulo.

THE ALLOY METAL WIRE Co., INC., Moore, Pa., has appointed Donald A. Crosset as secretary-treasurer and general manager in charge of production and sales.

CONSOLIDATED ASHCROFT HANCOCK Co., Bridgeport, Conn., has appointed Louis H. Brendel assistant sales manager of the Hancock Valve Division. He will assist M. S. Palmer, sales manager.

ROLLWAY BEARING Co., INC., Syracuse, N. Y., has appointed Fred W. Kulicke as its Philadelphia representative, succeeding the late John W. Firmin.

A. W. CASH Co., Decatur, Ill., has appointed the Gale Engineering Co., 136 Liberty St., New York as representative for the Combustion Control Division.

J. A. TUMBLER LABORATORIES, Baltimore, Md., because of fire damage to its plant is occupying quarters at 418 So. Hanover St.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1935	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	$867,000	$371,000
Middle Atlantic	$28,000	$370,000	2,715,000	1,834,000
South	1,258,000	30,000	8,098,000	5,377,000
Middle West	269,000	605,000	8,584,000	7,382,000
West of Mississippi	565,000	1,888,000	5,235,000	3,616,000
Far West	93,000	272,000	1,668,000	5,683,000
Canada	5,000,000	.....	11,845,000	1,320,000
Total	$7,204,000	$3,165,000	$39,012,000	$25,583,000

PROPOSED WORK BIDS ASKED

Brick Plant—Dr. Scott McKell, Chillicothe, O., is back of a project to construct a brick plant at Greenup, Ky. Estimated cost $500,000.

Briquette Plant—Coal Processing Corp., c/o Old Ben Coal Corp., 232 South Clark St., Chicago, Ill., plans the construction of a briquette plant at Superior, Wis. Estimated cost $80,000.

Carbon Dioxide Factory—Carbon Dioxide Co., c/o A. Willasten, Archt., Alaska Bldg., Seattle, Wash., is having plans prepared for the construction of a 45x106 ft. factory for the manufacture of carbon dioxide products.

Cement Plant—American Portland Cement Co., Foreman, Ark., plans additions and improvements to its plant here. Estimated cost $200,000.

Cement Plant—Idaho Portland Cement Co., Pocatello, Idaho, plans to construct an addition to its plant including a storage building. Estimated cost including equipment $65,000.

Distillery — American Distilling Co., c/o Charles B. Ralston, Chamber of Commerce, Staunton, Va., plans to construct a distilling plant. Estimated cost $400,000.

Distillery—H. L. Lambert, Kanawha Hotel, Charleston, W. Va., and St. Albans, W. Va., has acquired the plant formerly occupied by the Roessler & Hasslacher Chemical Co. at St. Albans, W. Va., and plans to recondition and equip same for a distillery. Estimated cost including equipment $300,000.

Distillery—Virginia Fruit Brandy Co., E. C. Knight, Rural Retreat, Va., in charge, plans to construct a distillery at North Garden, Va., to cost $30,000.

Gas Plant—City, Webster City, Ia., plans to remodel and improve its gas plant. Estimated cost $35,000.

Glass Factory—Owens Illinois Glass Co., 965 Wall St., Toledo, O., plans to construct a research and packaging plant, including air conditioning system. Estimated cost $30,000.

Glass Factory—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., plans to construct an addition to its factory. Estimated cost including equipment $150,000.

Glass Factory—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., plans to construct a modern glass factory at High Point, N. C. L. H. Hancock, High Point, Mgr. Estimated cost to exceed $28,000.

Laboratory—Cheplin Laboratories, 401 West Taylor St., Syracuse, N. Y., will construct an addition to its laboratory. Estimated cost $28,500.

Oil Refinery — Pettus Oil & Refining Co., Morris Roberts in charge, Pettus, Tex., contemplates the construction of an oil refinery in the vicinity of Mathis, Tex. Estimated cost $90,000.

Oil Refinery—Taylor Refining Co., c/o G. I. Rowsey, Taylor, Tex., plans to construct an oil refinery at Port Isabel, Tex., to include terminal facilities. Estimated cost $200,000.

Paint Factory—Stewart Paint Co., 1729 2nd St., Minneapolis, Minn., contemplates the construction of a paint manufacturing plant. E. J. Prondzinski, 107 South 4th St., Minneapolis, Minn., Archt. Estimated cost $40,000.

Pulp Mill—Mutual Pulp & Paper Mills, Prince Rupert, B. C., Can., plans the construction of a bleached sulphite pulp mill. Estimated cost $5,000,000.

CONTRACTS AWARDED

Distillery—J. C. McClure, Inc., Selma, Calif., awarded contract for brandy distillery on Huntsman Ave., Selma, to Trewhitt-Shields Co., Pacific S. W. Bldg., Fresno, Calif., $22,350.

Distillery—U. S. Industrial Alcohol Co., 60 East 42nd St., New York, N. Y., will construct a distillery and still house at New Orleans, La. Separate contracts have been awarded for the work. Structural steel to McClintic-Marshall Co., Bethlehem, Pa. Estimated cost exceeds $30,000.

Glass Factory—Owens-Illinois Glass Co., Alton, Ill., will build an addition to its plant. Work will be done by separate contracts. Structural steel let to McClintic-Marshall Co., Bethlehem, Pa. Estimated cost exceeds $30,000.

Factory—U. S. Industrial Alcohol Co., 400 Doremus Ave., Newark, N. J., awarded contract for factory to Barney-Ahlers Construction Corp., 101 Park Ave., New York, N. Y. Estimated cost $30,000.

Factory—General Aniline Works, Rensselaer, N. Y., manufacturer of dyes and chemicals, will build a 4 story addition to its factory. Separate contracts will be awarded. Estimated cost to exceed $28,000.

Glass Factory — Macbeth-Evans Glass Co., Charleroi, Pa., has awarded contract for the construction of a glass factory to Austin Co., Euclid Ave., Cleveland, O. Estimated cost will exceed $28,000.

Glass Factory—Obear-Nester Glass Co., Bway. and Southern Ry. tracks, East St. Louis, Ill., awarded contract for addition to factory to Amsler-Morton Construction Co., Fulton Bldg., Pittsburgh, Pa. Estimated cost $235,000.

Laboratory — International Nickel Co., 67 Wall St., New York, N. Y., awarded contract for laboratory and research building to Austin Co., 19 Rector St., New York, N. Y. All separate contracts have been awarded. Estimated cost will exceed $28,000.

Oil and Gas Development—Santa Rita Oil & Gas Co., Cut Bank, Mont., plans to develop oil and gas properties here. Work will be done by day labor. Estimated cost exceeds $28,000.

Oil Refinery—Crown Petroleum Co., Houston, Tex., awarded contract for oil refinery (distillation unit) to Alco Products Co., 220 East 42nd St., New York, N. Y. Estimated cost exceeds $100,000.

Oil Refinery—Magnolia Petroleum Co., Dallas, Tex., awarded contract for oil refinery to include cracking and topping units to W. M. Kellogg Co., 225 Bway., New York, N. Y. All separate contracts have been awarded. Estimated cost $1,500,000.

Oil Refinery — Pennzoil Co., Oil City, Pa., awarded contract for addition to refinery to Alco Products Co., Dunkirk, N. Y. Estimated cost exceeds $28,000.

Oil Refinery — Shell Petroleum Co., Wood River, Ill., awarded contract for stabilizing unit to Alco Products Co., Dunkirk, N. Y. Estimated cost exceeds $100,000.

Oil Refinery—Stockton Oil Co., 405 Montgomery St., San Francisco, Calif., is constructing an oil refinery at Rough and Ready Island, Stockton, by day labor. Estimated cost may exceed $75,000.

Oil Refinery—Valley Port Refining Co., c/o G. L. Rowsey, Taylor, Tex., awarded contract for oil refinery at Port Isabel, Tex., to Wyatt Metal & Boiler Works, 1901 West Commerce St., Dallas, and Washington St., Houston. Estimated cost $250,000.

Oil Refinery—Wadhams Oil Co., East Chicago, Ind., awarded contract for oil refinery to W. M. Kellogg Co., 225 Bway., New York, N. Y. All separate contracts have been awarded. Estimated cost $200,000.

Paint Factory—Solfo Paint & Chemical Co., 821 Pennington Ave., Trenton, N. J., awarded contract for an addition to its plant to W. C. Ehret, 209 Academy St., Trenton. Estimated cost exceeds $28,000.

Storage Building — F. W. Fitch Co., 15th and Walnut Sts., Des Moines, Ia., awarded contract for addition to its plant to be used for storage of raw materials to F. B. Dickinson Co., 118 Mulberry St., Des Moines. Estimated cost $10,000.

Sugar Refinery—Sucrest Corp., 111 Wall St., New York, N. Y., will build a cane sugar refinery at Richards St. and Erie Basin, Brooklyn, N. Y., to have an annual capacity of 3,000,000 bags.

Varnish Factory—E. I. du Pont de Nemours & Co., 601 3rd St., San Francisco, Calif., awarded contract for paint and varnish factory at South San Francisco, to Cahill Bros., 206 Sansome St., San Francisco. Estimated cost $175,000.

Warehouse—Hall China Co., East Liverpool, O., awarded contract for warehouse in Klondyke, East End of city, to Heller Bros., Youngstown, O. $40,000.

Warehouse—Sherwin Williams Co., Camden, N. J., awarded contract for warehouse at Lister and Brown Aves., Newark, N. J., to Austin Co., 17 Rector St., New York, N. Y. Estimated cost $100,000.

Vegetable Oils

(Continued from page 438)

ports from other countries for refining and manufacturing, much of which moved to the Midwest, greatest fat consuming center of the United States. Even this is not all, for California brought in from Texas and Arizona not less than 60,000,000 lb. of cottonseed oil, in view of which fact the bill recently passed by the California legislature whereby a 10c. tax was placed upon oleomargarine, if made from Philippine coconut oil, for the ostensible purpose, in part, of protecting California's cottonseed oil appears an absurdity.

Some of the largest and best equipped plants for refining and processing these crude oils are located here. Some of them are quite complex, and in their activities, cover every process from crushing the raw material to the final manufacturing and distribution of finished products. There are 76 paint factories and over 80 soap factories consuming approximately 300,000,000 lb. of oil each year, all produced locally or imported through Pacific ports and more or less processed on this coast. Twelve margarine factories consume more than 20,000,000 lb. of refined oils annually.

Every day oils of Pacific Coast production enter into some technical or edible use here or in the Eastern states. Table II shows the most important of these oils, their source and major uses, and will give some idea of the vast importance of this industry to the Pacific Coast, its far-reaching value to other countries, and its great influence upon international trade.

Power

(Continued from page 444)

Southern California: Attractive rates designed to encourage electro-chemical and metallurgical industries were recently established by the utilities in this section in anticipation of the advent of power from Boulder Dam. A prospective consumer with a demand ranging from 2,000 to 10,000 kw. can contract for power at a cost ranging from 2.5 mills per kw.-hr. upward.

One schedule carries a charge of 4.5 mills per kw.-hr. for the first 150 hours' use of the demand with all excess at 2.5 mills. A second rate carries a flat charge of 2.5 mills per kw.-hr. for all energy used, with a provision for 18 hours of daily use only, prohibiting use during evening peaks.

With the exception of two units in the Boulder Dam power plant reserved for Arizona and Nevada, the entire output has been contracted for by the Metropolitan Water District and the southern California serving utilities. In the event of the development of loads sufficient to warrant the investment, it may be assumed that lines will be constructed from Boulder Dam into these states. Switchboard costs of power at Boulder Dam are based upon a falling water charge of 1.63 mills per kw.-hr. In blocks of 25,000 kw. or more at 75 per cent load factor 100 miles from the power plant, it is estimated that the cost of the power would be approximately 3 mills.

Waste Disposal

(Continued from page 454)

products to a fineness that permits of disposal by the sewer route. For example, a disintegrator in a large California cannery within a period of 29 min. reduced a 15-ton carload of rejected peaches (including pits) to a condition such that they safely were pumped into the sewer.

The operation of such disintegrators ordinarily requires only part time attention by one man and the power cost is relatively low. There is on the Coast an increasing tendency to reduce pulpable solids for sewer disposal. (See the illustration on page 454.) This classification includes waste whose hardness ranges all the way from peach or apricot pits to fruit peelings or rotting tomatoes.

The advances of greatest importance in the sewered-waste problems have been relatively simple expedients. For example, a steel company had 10,000 gal. per day of 3 per cent sulphuric acid to dump into a small sewer. Discharged all at once this was a serious menace to the sewer pipes; delivered via acid-proof pipes to a storage tank whence there was controlled, continuous discharge into the public sewers, it was found that ample alkalinity was present for neutralization and no damage whatever resulted. Again, several cities of the San Joaquin Valley, to encourage creamery operation, have laid out new sewers with two pipe lines in each main trench—thus providing a separate or "industrial system" expressly for creamery wastes and permitting of specialized treatment at the sewage disposal plant. Other cities deliberately have adopted a type of sewage disposal fitted for handling the type of industrial waste prevalent in that locality. In still other cases simply keeping wash water separate from a difficult waste product sometimes may mean that the concentrated waste itself can be kept out of the sewer and handled separately.

Evaporators may avoid a serious waste problem—may even make an industrial plant practicable where otherwise it would not be. Because the costs are not at all unreasonable, evaporation as a solution of certain waste disposal problems opens up a field to which industrial plant managers may well be attentive.

Because of the importance of preventing pollution of streams and beaches by sanitary sewage, many cities have built treatment plants such as Imhoff tanks or other processes depending upon bacterial action. Where such treatment plants would be seriously affected by an industrial waste and yet where sewer disposal is desirable from the viewpoint of the industrial plant, private sewer lines occasionally are built. One of the most notable of these is the 16-mile, 30-in. sewer built from the Santa Fe Springs oil field (near Los Angeles) to the ocean shore.

This plant, of effective and novel design (described in *Engineering News-Record*, May 16, 1929, p. 795), is operated by the Santa Fe Springs Waste Water Disposal Co., a non-profit, co-operative organization of 20 oil producing companies. Salt water from nearby oil wells enters this plant with an oil content of 500 p.p.m. and is discharged with only 12 p.p.m. Until this plant was developed and means were found for this plan of (1) recovering the oil content and (2) disposing of the salt water, the several oil companies were threatened with legal action by land owners of the vicinity.

In the Pacific Northwest where rainfall is abundant and stream flow is large, the dilution ratio is a great aid in waste disposal. This is well illustrated by the studies recently made in connection with the discharge of sewage from the city of Spokane into the Spokane River. About 115,000 people live in the area tributary to Spokane's sewers and sewage is discharged into the river without treatment of any sort. Over a considerable period of time water samples were taken from the river at various points to determine the results of aeration and dilution. In the Columbia River just below the confluence of the Spokane the water was found consistently to be of a higher degree of purity than in the Spokane River *above* the city of Spokane.

In the disposal of various wastes heavier than water, sedimentation generally is given a much higher rating than the use of fine screens. A commonly accepted figure is that screens remove about 10 per cent of suspended solids as compared to 50 per cent or more taken out by sedimentation. Moreover, the screens often do not prevent the formation of sludge deposits to a degree at all comparable with what may be expected by sedimentation.

With the notable exception of Spokane, where a novel type of water grate incinerator has been developed, Pacific Coast cities generally have not had success with incineration as a means of garbage disposal. Incinerators are standing idle in several West Coast cities because less expensive means of disposal have been found. The method most widely used is the sanitary fill: a plan whereby garbage is hauled to a suitable location, dumped, spread and covered with fresh earth. Some of the largest cities (Seattle and San Francisco, for example) use this method exclusively and effectively. Dumping at sea (still used by the city of Oakland) has resulted in much protest about beach deposits.